

PROJECT MANUAL

Cincinnati Metropolitan Housing Authority Maple Tower RAD Renovations Cincinnati, Ohio

Prepared by
R.E. Warner & Associates, Inc.

601 Maple Avenue
Cincinnati Ohio 45229
Project Number 07425

SECTION 000110 - TABLE OF CONTENTS

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

INTRODUCTORY INFORMATION

000107	SEALS PAGE
000110	TABLE OF CONTENTS
000115	LIST OF DRAWING SHEETS
	INVITATION FOR BIDS
000130	SCHEDULE AND INSTRUCTIONS
	CONDITIONS OF THE SOLICITATION
	INDEX
	BID FORM
	BID BOND SAMPLE
	NON-COLLUSIVE AFFIDAVIT
	DISCLOSURE OF LOBBYING ACTIVITIES
	PREVIOUS PARTICIPATION CERTIFICATION
	REPRESENTATIONS, CERTIFICATIONS, AND
	OTHER STATEMENTS OF BIDDERS
	INSTRUCTIONS TO BIDDERS FOR CONTRACTS
	PUBLIC AND INDIAN HOUSING
	PROGRAMS
	REQUEST FOR BIDS
	SUPPLEMENTAL INSTRUCTIONS TO BIDDERS
	INVITATION FOR QUOTES
	CONSTRUCTION CONTRACT SAMPLE
	INVITATION FOR BIDS
	CONSTRUCTION GENERAL TERMS AND
	CONDITIONS
	MBE / WBE PARTICIPATION REPORT
	SECTION 3 RESIDENTS AND BUSINESS
	CONCERNS
	PREVAILING WAGES CLAUSE
	SCOPE OF WORK
000131	BID FORM ATTACHMENT – LIST OF ALTERNATES

PROCUREMENT REQUIREMENTS & CONTRACTING REQUIREMENTS

001113	ADVERTISEMENT FOR BIDS
002600	PROCUREMENT SUBSTITUTION PROCEDURES
003126	EXISTING HAZARDOUS MATERIAL INFORMATION
003143	PERMIT APPLICATION
004373	PROPOSED SCHEDULE OF VALUES FORM
006313.13	REQUEST FOR INTERPRETATION FORM (RFI), BIDDING
	PHASE

006313.16	REQUEST FOR INTERPRETATION FORM (RFI), CONSTRUCTION PHASE
006325	REQUEST FOR SUBSTITUTION FORM, CONSTRUCTION PHASE

SPECIFICATIONS GROUP

GENERAL REQUIREMENTS SUBGROUP

DIVISION 01 - GENERAL REQUIREMENTS

011000	SUMMARY
012100	ALLOWANCES
012300	ALTERNATES
012500	SUBSTITUTION PROCEDURES
012600	CONTRACT MODIFICATION PROCEDURES
012900	PAYMENT PROCEDURES
013100	PROJECT MANAGEMENT AND COORDINATION
013200	CONSTRUCTION PROGRESS DOCUMENTATION
013233	PHOTOGRAPHIC DOCUMENTATION
013300	SUBMITTAL PROCEDURES
013516	ALTERATION PROJECT PROCEDURES
014000	QUALITY REQUIREMENTS
014200	REFERENCES
015639	TEMPORARY TREE AND PLANT PROTECTION
016000	PRODUCT REQUIREMENTS
017300	EXECUTION
017419	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
017700	CLOSEOUT PROCEDURES
017823	OPERATION AND MAINTENANCE DATA
017839	PROJECT RECORD DOCUMENTS
017900	DEMONSTRATION AND TRAINING
018113	SUSTAINABLE DESIGN REQUIREMENTS – EGC 2020
019112	TESTING AND VERIFICATION PLAN

FACILITY CONSTRUCTION SUBGROUP

DIVISION 02 - EXISTING CONDITIONS

024119	SELECTIVE DEMOLITION

DIVISION 04 - MASONRY

042213	SITE CONCRETE UNIT MASONRY
044216	SITE STONE BLOCKS, BOULDERS AND SLABS

DIVISION 05 - METALS

055214	SITE GUARD AND HAND RAILINGS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

072100	THERMAL INSULATION
079200	JOINT SEALANTS

DIVISION 08 - OPENINGS

081213	HOLLOW METAL FRAMES
081416	FLUSH WOOD DOORS
087111	DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)

DIVISION 09 - FINISHES

090190.52	MAINTENANCE REPAINTING
092216	NON-STRUCTURAL METAL FRAMING
092900	GYPSUM BOARD
095113	ACOUSTICAL PANEL CEILINGS
096513	RESILIENT BASE AND ACCESSORIES
096519	RESILIENT TILE FLOORING
099114	EXTERIOR PAINTING (MPI STANDARDS)
099124	INTERIOR PAINTING (MPI STANDARDS)

DIVISION 10 - SPECIALTIES

101423.16	ROOM-IDENTIFICATION PANEL SIGNAGE
102600	WALL AND DOOR PROTECTION
102800	TOILET, BATH, AND LAUNDRY ACCESSORIES
105500.13	USPS-DELIVERY POSTAL SPECIALTIES

DIVISION 11 - EQUIPMENT

113013	RESIDENTIAL APPLIANCES

DIVISION 12 - FURNISHINGS

123530	RESIDENTIAL CASEWORK
123623.13	PLASTIC-LAMINATE-CLAD COUNTERTOPS
123661	SIMULATED STONE COUNTERTOPS

DIVISION 22 - PLUMBING

220500	COMMON WORK RESULTS FOR PLUMBING
220510	PLUMBING DEMOLITION AND ALTERATIONS
220519	METERS AND GAUGES FOR PLUMBING PIPING
220523	GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220550	VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220700	PLUMBING INSULATION
222116	DOMESTIC WATER PIPING
222119	DOMESTIC WATER PIPING SPECIALTIES

221316	SANITARY WASTE AND VENT PIPING
221319	SANITARY WASTE PIPING SPECIALTIES
223400	FUEL-FIRED DOMESTIC WATER HEATERS
224000	PLUMBING FIXTURES
227000	FUEL GAS PIPING
230500	COMMON WORK RESULTS FOR HVAC
230510	HVAC DEMOLITION AND ALTERATIONS
230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230523	GENERAL-DUTY VALVES FOR HYDRONIC PIPING
230529	HANGERS AND SUPPORTS FOR HVAC
230550	VIBRATION CONTROLS FOR HVAC
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING ADJUSTING AND BALANCING FOR HVAC
230700	HVAC INSULATION
230900	INSTRUMENTATION AND CONTROL FOR HVAC
232113	HYDRONIC PIPING
232117	HYDRONIC PIPING SPECIALTIES
232123	HYDRONIC PUMPS
232300	REFRIGERANT PIPING
233113	METAL DUCTS
233300	AIR DUCT ACCESSORIES
233400	FANS
233713	DIFFUSERS, REGISTERS, AND GRILLES
234100	AIR FILTERS
235123	GAS VENTS
235216	CONDENSING BOILERS
236200	PACKAGED COMPRESSOR AND CONDENSER UNITS
238113	PACKAGED TERMINAL AIR-CONDITIONERS
238126	DUCTLESS DX SPLIT SYSTEMS
238219	BLOWER COIL UNITS

DIVISION 26 - ELECTRICAL

260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260533.13	CONDUITS FOR ELECTRICAL SYSTEMS
260533.16	BOXES AND COVERS FOR ELECTRICAL SYSTEMS
260536	CABLE TRAYS FOR ELECTRICAL SYSTEMS
260543	UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
262413	SWITCHBOARDS
262416	PANELBOARDS
262726	WIRING DEVICES
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
263600	TRANSFER SWITCHES

DIVISION 31 - EARTHWORK

312219	LANDSCAPE & FINE GRADING

DIVISION 32 – EXTERIOR IMPROVEMENTS

321313	LANDSCAPE ARCHITECTURAL CEMENT CONCRETE PAVING
321316	ARCHITECTURAL AND DECORATIVE CEMENT CONCRETE PAVING
321323	CAST-IN-PLACE CONCRETE FOR LANDSCAPE ELEMENTS
321400	UNIT PAVING SYSTEMS
323113	CHAIN LINK FENCES AND GATES
323300	SITE FURNISHINGS
329113	SOIL PREPARATION
329200	LAWNS & GRASSES
329300	TREES, SHRUBS, VINES & GROUNDCOVERS
329400	LANDSCAPE PLANTING ACCESSORIES
329813	LANDSCAPE ESTABLISHMENT PERIOD

DIVISION 33 - UTILITIES

334300	LANDSCAPE DRAINAGE

END OF TABLE OF CONTENTS

SECTION 000115 - LIST OF DRAWING SHEETS

PART 1 - GENERAL

1.1 LIST OF DRAWINGS

- A. Drawings: Drawings that will be enumerated in the Owner/Contractor Agreement as part of the Contract Documents are listed on the Table of Contents page of the separately bound drawing set titled RAD RENOVATIONS PROJECT DRAWING LIST, dated June 2, 2025, as modified by subsequent Addenda and Modifications.

1. The words "Resource Drawing" or "For information" after the titles of drawings indicate that those drawings are not intended to be incorporated in the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 000115



**INVITATION FOR BIDS
SCHEDULE AND INSTRUCTIONS**

CINCINNATI METROPOLITAN HOUSING AUTHORITY

**SOLICITATION 2025-3010: Maple Tower RAD Conversion
Renovations**

PROJECT MANUAL

DATE ISSUED	July 21, 2025
OPTIONAL SITE VISIT/WALK THROUGH	July 30, 2025 @ 10:00 Meet at 601 Maple Ave., Cincinnati, OH It is suggested that the attendees have read the Scope of Work
LAST DATE FOR QUESTIONS	Questions shall be submitted in writing to michael.koch@cintimha.com . Responses to questions will be posted as an addendum to the website along with the other solicitation documents.
PROPOSAL SUBMITTAL DEADLINE & PUBLIC OPENING	Bid due date: August 21, 2025 @ 10:00a.m. Sealed Hard Copy Bids must be delivered to: Cincinnati Metropolitan Housing Authority 1627 Western Ave. Cincinnati OH 45214
WHAT TO SUBMIT	Bid Package MUST include the following documents: 1. Bid Form 2. Bid Bond 3. Non-Collusive Affidavit 4. Disclosure of Lobbying Activities, 5. Form HUD-2530, 6. Form HUD-5369A
NOTICE OF INTENT TO SUBMIT	It is suggested that interested companies submit a Notice of Intent to submit a proposal to procurement@cintimha.com . By indicating your intent to submit a proposal you will receive notice of any addenda posted.
CONSTRUCTION TIME	420 Calendar days from the date stated in the “Notice to Proceed”

CMHA Reserves the right to modify this schedule at its discretion.



INVITATION FOR BIDS CONDITIONS OF THE SOLICITATION

1. In 2012, CMHA established its Gold Performance Standards which consist of the principles and values by which the Agency performs and how our partners, vendors, contractors and consultants are measured.

The Gold Performance Standards are: Respect, Timely, Exceptional, Initiative, Excellent, Quality, Accurate, Integrity, Value, Creativity, Accountability and Professionalism.

It is CMHA's intent to procure Contractors that share these standards and can clearly demonstrate the services they can provide CMHA that no other contractor can offer. It's very imperative that our partners, vendors, contractors and consultants abide by these standards that have been established.

2. The Contractor shall hold the offer for 335 days after Bid Due Date.
3. Notification of changes in the form of Addendums will be made available to all interested parties via an email and/or by posting on CMHA's website.
4. Only the documents stated on the Solicitation as required will be evaluated. DO NOT include additional documents like, but not limited to: references, licenses, curriculum vitae, previous job pictures. Submitting additional documents may cause the proposal to be unresponsive.
5. This project is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended. Preference may be given in accordance with 24 CFR 135 and the CMHA procurement policy.
6. The Prevailing Wages shall be paid for a legal day's work to laborers, workmen or mechanics engaged in work under this Contract, at the site of the Project, in the trade or occupation listed.
7. The Authority reserves the right to reject and not consider any proposal that does not meet the requirements of this Solicitation, including but not necessarily limited to incomplete proposals and/or proposals offering alternate or non-requested services, proposals deemed non-responsive, respondents deemed not responsible, and conditional proposals.
8. The responsibility for submitting a response to this request at the designated office of the Cincinnati Metropolitan Housing Authority on or before the stated time and date will be solely and strictly of the Proposer. The Authority will in no way be responsible for the delays caused by the delivery manner chosen by the respondent or caused by any other occurrence.

END OF CONDITIONS



INVITATION FOR BIDS INDEX

SECTION	PAGE
1. <u>Schedule and Instructions</u>	<u>1</u>
2. <u>Conditions of the Solicitation</u>	<u>2</u>
3. <u>Index</u>	<u>3</u>
4. <u>Bid Form <i>Fill, Sign and Return</i></u>	<u>4</u>
5. <u>Bid Bond Sample <i>Bid Bond Form Sample for Reference</i></u>	<u>10</u>
6. <u>Non-Collusive Affidavit <i>Fill, Sign and Return.</i></u>	<u>12</u>
7. <u>Disclosure of Lobbying Activities <i>Fill, Sign and Return.</i></u>	<u>13</u>
8. <u>Form HUD-2530 Previous Certificate Participation <i>Fill, Sign and Return.</i></u>	<u>14</u>
9. <u>Form HUD-5369A <i>Fill, Sign and Return</i></u> <u>Representations, Certifications, and other Statements of Bidders, Public and Indian Housing Programs</u>	<u>18</u>
10. <u>Form HUD-5369</u> <u>Instructions to Bidders for Contracts Public & Indian Housing Programs</u>	<u>22</u>
11. <u>CMHA Supplemental Instructions to Bidders (SITB)</u>	<u>27</u>
12. <u>Construction Contract Sample</u>	<u>31</u>
13. <u>Construction General Terms and Conditions</u>	<u>34</u>
14. <u>MBE/WBE Participation Report</u>	<u>128</u>
15. <u>Section 3 (S3) Residents and Business Concerns</u>	<u>129</u>
16. <u>Prevailing Wages Clause</u>	<u>133</u>
17. <u>Scope of Work – PLEASE REFER TO DRAWINGS AND SPECIFICATIONS FIRST. IF THERE ARE ANY DISCREPANCIES NOTIFY CMHA/ARCHITECT VIA RFI</u>	<u>135</u>
18. <u>Wage Determination Rates</u>	<u>Attachment 1</u>

END OF INDEX



INVITATION FOR BIDS
BID FORM

SOLICITATION No. 2025-3010 - PROPOSAL
TO THE CINCINNATI METROPOLITAN HOUSING AUTHORITY (CMHA)

In submitting this proposal, _____ understands that the right is reserved by the Cincinnati Metropolitan Housing Authority to reject any and all Proposals. If written notice of the acceptance of this proposal is mailed, telegraphed or delivered to the undersigned within 330 days after the opening thereof, or at any time thereafter before this proposal is withdrawn, the undersigned agrees to execute and deliver a contract in the prescribed form and furnish the required bond and insurance certifications no later than 10 days after the "Notice of Intent".

1. Total Proposal Amount (TPA)

The base proposal to include all work indicated, administrative costs and Addendums, is

Figure _____ Dollars.

Words

Note: The Total Proposal Amount shall be shown in both words and figures; in case of discrepancy, the amount in words shall govern. To be valid proposal, the Fee Submission Form must be filled out in its entirety with all certifications and affidavits. It must be submitted with and is part of the Proposal Packet.

Attached hereto is an affidavit in proof that the undersigned has not entered into any collusion with any person in respect to this proposal or any other proposal or the submitting of Proposals for the contract for which this proposal is submitted. Also attached is a completed Form HUD-5369-A, Representations, Certifications, and Other Statements of Bidders.

Work under this Contract will begin immediately upon the successful Contractor's receipt of a "Notice to Proceed" from CMHA. The "Notice to Proceed" will follow the completion of an executed contract.

2. Bid Bond

A Bid Bond of 10% of the Total Proposal Amount is included in the Proposal

Figure _____ Dollars.

Words

INVITATION FOR BIDS

BID FORM

All bid bonds be a shall be issued by Surety Companies licensed to issue bonds in the State of Ohio and listed in Federal Register Circular #570. The current power of attorney for the person who signs for any surety company shall be attached to the bid bond.

The CMHA will have the right to retain the bid security of bidders to whom an award is being considered until either (a) the contract has been executed and bonds, if required, have been executed, (b) the specified time has elapsed so that bids may be withdrawn, or (c) all bids have been rejected.

3. Acknowledgment's

I acknowledge receipt and acceptance of the following:

- Scope of Work
- General Contract Conditions (HUD-5370)
- MBE/WBE Participation Report
- S3 Residents and Business Concerns
- Prevailing Wages Clause
- Wage Determination Rates
- Addendum No. _____ Dated: _____
- Addendum No. _____ Dated: _____
- Addendum No. _____ Dated: _____

4. Basis of Contract Award

CMHA intends to award this contract to the Lowest Responsive Bidder complying with these Public Bid Specifications, Drawings and Addenda, if any, provided the Contractor's proposal is reasonable and in the best interest of CMHA to accept it.

5. Contract Time

The contract performance period from the “Notice to Proceed” until Substantial Completion, will be 420 Calendar Days.

6. Unit Alternate

Refer to specification section 000131 and this **MUST** be attached to bid form.

7. Assurance of Compliance

The successful Bidder shall furnish an assurance of completion prior to the execution of any contract under this solicitation in the form of a performance and payment bond in a penal sum of 100 percent of the contract price.



INVITATION FOR BIDS BID FORM

8. Minority Business Enterprise (MBE) & Women Business Enterprise(WBE)

The contractor agrees to make its best effort to expend at least 20% of the total dollar amount of the Contract on Minority Business Enterprises (MBE), an entity with at least 51% ownership interest by a minority in business), and at least 5% of the Contract to a Women Business Enterprises (WBE), an entity with a least 51% ownership interest by a woman in business.

Prior to award of Contract, the Contractor will submit documents in support of its best efforts to achieve the above stated MBE/WBE participation. Best efforts may be established by documenting that the Contractor:

- Has made efforts to identify appropriate MBE/WBE contractors through community contacts or MBE and WBE associations.
- Has contacted CMHA's Economic Inclusion Coordinator to help identify potential
- MBE/WBE companies appropriate for the project.
- Has contacted and solicited proposals/Proposals from selected MBE/WBE companies.

Contractors agrees to promptly complete and return all required reports confirming MBE/WBE participation, including Proposed, Amended, and Final MBE/WBE Participation Forms. If requested by CMHA, the Contractor agrees to submit proof of payment made to each MBE/WBE subcontractor listed on the MBE/WBE Participation Report.

Request for complete or partial waiver of the contractor's MBE/WBE participation goals must be made in writing, stating all details in the request, the circumstances, and all relevant information. The request must be accompanied by a record of all efforts taken by the Bidder/Bidder to locate MBE/WBEs, solicit MBE/WBEs, seek assistance from CMHA's Economic Inclusion Coordinator, or seek help from other community/business resources or technical assistance agencies. CMHA will respond in writing to the Waiver Request within five (5) business days upon receipt.

9. Section 3 Certification of Preference

Please note that a contract with the Cincinnati Metropolitan Housing Authority is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended and to the Section 3 Action Plan submitted with the proposal for this project.

Type of Business (check all that apply)

☐ Corporation	☐ Partnership	☐ Sole Proprietorship	☐ Joint Venture
☐ LLC	☐ MBE	☐ WBE	☐

You self-certify that your business has documented within the last six months a Section 3 Business Concern based on one of the eligibility criteria below. (Check the one that qualifies your business):

- ☐ **Category 1:** 51 percent or more owned and controlled by low- or very low-income people (based on household income under HUD-income limits)
- ☐ **Category 2:** 75 percent or more of the business labor hours to perform the business are performed by low-very low-income people.
- ☐ **Category 3:** 51 percent owned and controlled by current residents of public housing or Section 8-assisted housing.
- ☐ My business does not meet the Section 3 eligibility criteria and wishes to forgo Section 3



INVITATION FOR BIDS BID FORM

preferences in the awarding of this contract but understand that we are still responsible for meeting Section 3 compliance.

10. Section 3 – Action Plan

Please check any and all efforts from the below mentioned categories that your company will utilize to:

- Y Recruit, solicit, encourage, facilitate and hire Section 3 Workers when new hiring/training opportunities are generated through the awarding of the contract.
- Y Recruit, solicit, encourage, facilitate and Subcontract with Section 3 Business Concerns when new subcontracting opportunities are generated through the awarding of the contract.

Your acknowledgment is still needed, so please check accordingly. The Section 3 Action Plan is subject to audit at any time during the awarding of the contract through the duration of the contract by the Section 3 Compliance Coordinator

You are required to provide opportunities to “the greatest extent feasible” in order to comply with the requirements of Section 3. In the event that you are not able to hire/train and/or contract with Section 3 Residents and/or Section 3 Business Concerns, you will be required to document why you were unable to meet the numerical goals.

a. Opportunities Strategies - Hiring / Training

- **Mandatory** Commit that the company and/or subcontractors as a result of the contract, 25% of the labor hours will be Section 3 Workers.
- **Mandatory** Contact the CMHA Section 3 Compliance Coordinator regarding employment and training opportunities.
- **Mandatory** Provide the CMHA Section 3 Compliance Coordinator with a monthly report listing all employment and training opportunities.
- **Mandatory** Post notice (placards) at the worksite where the work is being done, indicating any employment and training opportunities
- Facilitate or co-facilitate Hiring Halls within close proximity to where the work is being done for Section 3 Workers and Tags.
- Contact/Meet with Resident Associations informing them of new training and employment opportunities.
- Advertise new training and employment opportunities in community and diversity newspapers/websites.
- Sponsor or participate in job informational meetings or job fairs in the neighborhood or service area of the Section 3 covered project.
- Establish an internal training program (pre-apprenticeship) that is consistent with Dept. of Labor requirements to provide Section 3 Workers with the opportunity to learn skills and job requirements.
- Distribute flyers to CMHA owned sites indicating the number and types of jobs that will be offered with contact information.
- Maintain a file of eligible qualified Section 3 Workers and Targeted Section 3 Workers for future employment opportunities.



INVITATION FOR BIDS BID FORM

- Incorporate into contract (after selection of Bidders but prior to the execution of contracts), a negotiated provision for a specific number of Section 3 Workers to be trained and/or employed during the contract.
- Other:

b. Opportunities Strategies - Subcontracting

- **Mandatory** Contact the CMHA Section 3 Compliance Coordinator regarding all new subcontracting opportunities.
- **Mandatory** Provide the CMHA Section 3 Compliance Coordinator with a monthly report
- listing all subcontracting opportunities.
- Advertise new contracting opportunities in community and diversity newspapers/websites.
- Maintain a file of eligible qualified Section 3 Business Concerns for future contracting opportunities.
- Incorporate into contract (after selection of Bidders but prior to the execution of contracts), a negotiated provision for a specific amount of work to be contracted with Section 3 Business Concern(s) during the contract.
- Sponsor or participate in minority, women, small business expositions and or conferences in the Cincinnati, Ohio area to network and promote contracting opportunities with Section 3 Business Concern
- Outreach to business assistance agencies, minority contracting associations, community organizations, to network and promote contracting opportunities with Section 3 Business Concerns.
- Contact/Meet with Resident Associations informing them of new contracting opportunities.
- Outreach to trade/labor organizations to network and promote contracting opportunities
- with Section 3 Business Concerns.
- Host/Facilitate workshops geared to Section 3 Business concerns on contracting procedures and opportunities.
- Become an active mentor to Section 3 Business Concerns.
- Other:



**INVITATION FOR BIDS
BID BOND SAMPLE**

The undersigned is familiar with the local conditions, regulations and codes affecting the cost of the work, and with the Drawings and Specifications, issued and Addenda, if any thereto.

The penalty for making false statements in any offer is prescribed in 19 U.S.C. 1001.

FILL WITH LEGIBLE BLOCK LETTERS

Amount: _____

Legal Business Name: _____

DBA Name (If Applicable): _____

Business Address: _____

City, State, Zip: _____

Fed. Tax ID: _____

Business SAM.gov Unique Entity ID: _____

Email / Phone No.: _____

Signature: _____

Name: _____

Title: _____

Direct to Section3@cintimha.com any questions regarding CMHA's:

- MBE/WBE Program
- Section 3 Business Concerns

KNOWN ALL MEN BY THESE PRESENTS, that we:

(Insert full name and address or legal title of Contractor) as

Principal, hereinafter called the principle, and:

(Insert full name and address or legal title of Surety)

a corporation duly organized under the laws of the State of:

_____ as Surety, hereinafter called the Surety,

are held and firmly bound unto:



**INVITATION FOR BIDS
BID BOND SAMPLE**

(Insert full name and address or legal title of Owner) hereinafter called

the Obligee, in the sum of (10% of Bid):

_____DOLLARS
(In Words)

\$_____

for payment of which sum, well and truly to be made, we hereby jointly bind ourselves, our heirs, executors, administrators, successors and assigns. The CONDITION OF THIS OBLIGATION IS SUCH, that whereas, the Principal has submitted the accompanying bid, dated:

_____20_____for _____



**INVITATION FOR BIDS
BID BOND SAMPLE**

NOW, THEREFORE, if the Obligee shall accept the Bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such Bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference between the amount specified in said Bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bond, then this obligation shall be null and void, otherwise to remain in full force and effect.

SIGNED SEALED AND DATED THIS _____ DAY OF _____, 20____

WITNESS

PRINCIPAL

BY _____

SURETY

BY _____

Note: In lieu of such bond, the Bidder shall include with his proposal, a Certified Check, Bank Draft, or U.S. Government Bond at par value, payable to the Obligee.

Certified Check for _____

DOLLARS - ON _____ BANK OF _____

DEPOSITED HERewith

BIDDER

BY _____

TITLE



**INVITATION FOR BIDS
NON-COLLUSIVE AFFIDAVIT**

TO THE CINCINNATI METROPOLITAN HOUSING AUTHORITY (CMHA)

State of _____

County of _____

_____, being first sworn, deposes:

and says that he is ☐ sole owner, ☐ partner, ☐ other _____ of
(Firm Name) _____

the party making the foregoing proposal or bid, that such proposal or bid is genuine and not collusive or sham; that aspired, connived or agreed, directly or indirectly, with any bidder or person, to put in a sham bid or to refrain from bidding, and has not in any manner, directly, or indirectly, sought by agreement or collusion, or communication or conference, with any person, to fix the bid price of affiant or of any other bidder, or to fix any overhead, profit or cost element of said bid price, to secure any advantage against the Cincinnati Metropolitan Housing Authority or any person interested in the proposed contract; and that all statements in said proposal or bid are true.

Signature of Bidder: (If Individual)

Signature of Bidder: (If Partnership)

Signature of Bidder: (If Corporation)

Subscribed and sworn to before me this _____ day of _____, 20_____

_____. My commission expires _____, 20_____. Notary Public



**INVITATION FOR BIDS
DISCLOSURE OF LOBBYING ACTIVITIES**

FOR CONTRACTS, GRANTS, LOANS AND COOPERATIVE AGREEMENTS

The undersigned certifies, to the best of his or her knowledge and belief that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan, or cooperative agreement.
2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL "Disclosure Form to Report Lobbying," in accordance with its instructions.
3. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Fill with legible block letters

Signature: _____

Name: _____

Title: _____

Date: _____

Covered Action: _____

Type and identify program, project or activity

Previous Participation Certification

OMB Approval No. 2502-0118

(Exp. 05/31/2019)

US Department of Housing and Urban Development Office of Housing/Federal Housing Commissioner

US Department of Agriculture Farmers Home Administration

Part I to be completed by Principals of Multifamily Projects (See instructions)		For HUD HQ/FmHA use only	
Reason for submission:			
1. Agency name and City where the application is filed		2. Project Name, Project Number, City and Zip Code	
3. Loan or Contract amount \$	4. Number of Units or Beds	5. Section of Act	6. Type of Project (check one) ☐ Existing ☐ Rehabilitation ☐ Proposed (New)

7. List all proposed Principals and attach organization chart for all organizations

Name and address of Principals and Affiliates (Name: Last, First, Middle Initial) proposing to participate	8 Role of Each Principal in Project	9. SSN or IRS Employer Number

Certifications: The principal(s) listed above hereby apply to HUD or USDA FmHA, as the case maybe, for approval to participate as principal(s) in the role(s) and project listed above. The principal(s) each certify that all the statements made on this form are true, complete and correct to the best of their knowledge and belief and are made in good faith, including any Exhibits attached to this form. **Warning:** HUD will prosecute false claims and statements. Conviction may result in criminal and/or civil penalties. The principal(s) further certify that to the best of their knowledge and belief:

- Schedule A contains a listing, for the last ten years, of every project assisted or insured by HUD, USDA FmHA and/or State and local government housing finance agencies in which the principal(s) have participated or are now participating.
- For the period beginning 10 years prior to the date of this certification, and except as shown on the certification:
 - No mortgage on a project listed has ever been in default, assigned to the Government or foreclosed, nor has it received mortgage relief from the mortgagee;
 - The principals have no defaults or noncompliance under any Conventional Contract or Turnkey Contract of Sale in connection with a public housing project;
 - There are no known unresolved findings as a result of HUD audits, management reviews or other Governmental investigations concerning the principals or their projects;
 - There has not been a suspension or termination of payments under any HUD assistance contract due to the principal's fault or negligence;
 - The principals have not been convicted of a felony and are not presently the subject of a complaint or indictment charging a felony. (A felony is defined as any offense punishable by imprisonment for a term exceeding one year, but does not include any offense classified as a misdemeanor under the laws of a State and punishable by imprisonment of two years or less);
 - The principals have not been suspended, debarred or otherwise restricted by any Department or Agency of the Federal Government or of a State Government from doing business with such Department or Agency;
 - The principals have not defaulted on an obligation covered by a surety or performance bond and have not been the subject of a claim under an employee fidelity bond;
- All the names of the principals who propose to participate in this project are listed above.
- None of the principals is a HUD/FmHA employee or a member of a HUD/FmHA employee's immediate household as defined in Standards of Ethical Conduct for Employees of the Executive Branch in 5 C.F.R. Part 2635 (57 FR 35006) and HUD's Standard of Conduct in 24 C.F.R. Part 0 and USDA's Standard of Conduct in 7 C.F.R. Part 0 Subpart B.
- None of the principals is a participant in an assisted or insured project as of this date on which construction has stopped for a period in excess of 20 days or which has been substantially completed for more than 90 days and documents for closing, including final cost certification, have not been filed with HUD or FmHA.
- None of the principals have been found by HUD or FmHA to be in noncompliance with any applicable fair housing and civil rights requirements in 24 CFR 5.105(a). (If any principals or affiliates have been found to be in noncompliance with any requirements, attach a signed statement explaining the relevant facts, circumstances, and resolution, if any).
- None of the principals is a Member of Congress or a Resident Commissioner nor otherwise prohibited or limited by law from contracting with the Government of the United States of America.
- Statements above (if any) to which the principal(s) cannot certify have been deleted by striking through the words with a pen, and the relevant principal(s) have initialed each deletion (if any) and have attached a true and accurate signed statement (if applicable) to explain the facts and circumstances.

Name of Principal	Signature of Principal	Certification Date(mm/dd/yyyy)	Area Code and Tel. No.
This form prepared by (print name)		Area Code and Tel. No.	

Previous Participation Certification

Schedule A: List of Previous Projects and Section 8 Contracts. Below is a complete list of the principals’ previous participation projects and participation history in multifamily Housing programs of HUD/FmHA, State and local Housing Finance Agencies. **Note:** Read and follow the instruction sheet carefully. Make full disclosure. Add extra sheets if you need more space. Double check for accuracy. If no previous projects, write by your name, “**No previous participation, First Experience**”.

1. Principals Name (Last, First)	2. List of previous projects (Project name, project ID and, Govt. agency involved)	3.List Principals’ Role(s) (indicate dates participated, and if fee or identity of interest participant)	4. Status of loan (current, defaulted, assigned, foreclosed)	5. Was the Project ever in default during your participation Yes No If yes, explain			6. Last MOR rating and Physical Insp. Score and date

Part II- For HUD Internal Processing Only

Received and checked by me for accuracy and completeness; recommend approval or refer to Headquarters after checking appropriate box.

Date (mm/dd/yyyy)	Tel No. and area code	☐ A. No adverse information; form HUD-2530 approval recommended.	C. Disclosure or Certification problem	
Staff	Processing and Control			
		☐ B. Name match in system	D. Other (attach memorandum)	
Supervisor	Director of Housing/Director, Multifamily Division		Approved ☐ Yes ☐ No	Date (mm/dd/yyyy)

IFB Project Manual Rev. 1 (10/24)

Instructions for Completing the Previous Participation Certificate, form HUD-2530

Carefully read these instructions and the applicable regulations. A copy of those regulations published at 24 C.F.R. 200.210 to 200.245 can be obtained from the Multifamily Housing Representative at any HUD Office. Type or print neatly in ink when filling out this form. Mark answers in all blocks of the form. If the form is not filled completely, it will delay approval of your application.

Attach extra sheets as you need them. Be sure to indicate "Continued on Attachments" wherever appropriate. Sign each additional page that you attach if it refers to you or your record.

Carefully read the certification before you sign it. Any questions regarding the form or how to complete it can be answered by your HUD Office Multifamily Housing Representative.

Purpose: This form provides HUD with a certified report of all previous participation in HUD multifamily housing projects by those parties making application. The information requested in this form is used by HUD to determine if you meet the standards established to ensure that all principal participants in HUD projects will honor their legal, financial and contractual obligations and are acceptable risks from the underwriting standpoint of an insurer, lender or governmental agency. HUD requires that you certify your record of previous participation in HUD/USDA-FmHA, State and Local Housing Finance Agency projects by completing and signing this form, before your project application or participation can be approved.

HUD approval of your certification is a necessary precondition for your participation in the project and in the capacity that you propose. If you do not file this certification, do not furnish the information requested accurately, or do not meet established standards, HUD will not approve your certification.

Note that approval of your certification does not obligate HUD to approve your project application, and it does not satisfy all other HUD program requirements relative to your qualifications.

Who Must Sign and File Form HUD-2530:

Form HUD-2530 must be completed and signed by all principals applying to participate in HUD multifamily housing projects, including those who have no previous participation. The form must be signed and filed by all principals and their affiliates who propose participating in the HUD project. Use a separate form for each role in the HUD project. Use a separate form for each role in the project unless there is an identity of interest.

Principals include all individuals, joint ventures,

partnerships, corporations, trusts, non-profit organizations, any other public or private entity that will participate in the proposed project as a sponsor, owner, prime contractor, turnkey developer, managing agent, nursing home administrator or operator, packager, or consultant. Architects and attorneys who have any interest in the project other than an arm's length fee arrangement for professional services are also considered principals by HUD.

In the case of partnerships, all general partners regardless of their percentage interest and limited partners having a 25 percent or more interest in the partnership are considered principals. In the case of public or private corporations or governmental entities, principals include the president, vice president, secretary, treasurer and all other executive officers who are directly responsible to the board of directors, or any equivalent governing body, as well as all directors and each stockholder having a 10 percent or more interest in the corporation.

Affiliates are defined as any person or business concern that directly or indirectly controls the policy of a principal or has the power to do so. A holding or parent corporation would be an example of an affiliate if one of its subsidiaries is a principal.

Exception for Corporations – All principals and affiliates must personally sign the certificate except in the following situation. When a corporation is a principal, all of its officers, directors, trustees and stockholders with 10 percent or more of the common (voting) stock need not sign personally if they all have the same record to report. The officer who is authorized to sign for the corporation or agency will list the names and title of those who elect not to sign. However, any person who has a record of participation in HUD projects that is separate from that of his or her organization must report that activity on this form and sign his or her name. The objective is full disclosure.

Exemptions – The names of the following parties do not need to be listed on form HUD-2530: Public Housing Agencies, tenants, owners of less than five condominium or cooperative units and all others whose interests were acquired by inheritance or court order.

Where and When Form HUD-2530 Must Be

Filed: The original of this form must be submitted to the HUD Office where your project application will be processed at the same time you file your initial project application. This form must be filed with applications for projects, or when otherwise required in the situations listed below:

- Projects to be financed with mortgages insured under the National Housing Act (FHA).
- Projects to be financed according to Section 202 of the Housing Act of 1959 (Elderly and

Handicapped).

- Projects in which 20 percent or more of the units are to receive a subsidy as described in 24 C.F.R. 200.213.
- Purchase of a project subject to a mortgage insured or held by the Secretary of HUD.
- Purchase of a Secretary-owned project.
- Proposed substitution or addition of a principal or principal participation in a different capacity from that previously approved for the same project.
- Proposed acquisition by an existing limited partner of an additional interest in a project resulting in a total interest of 25 percent or more or proposed acquisition by a corporate stockholder of an additional interest in a project resulting in a total interest of 10 percent or more.
- Projects with U.S.D.A., Farmers Home Administration, or with state or local government housing finance agencies that include rental assistance under Section 8 of the Housing Act of 1937. For projects of this type, form HUD-2530 should be filed with the appropriate applications directly to those agencies.

Review of Adverse Determination: If approval of your participation in a HUD project is denied, withheld, or conditionally granted on the basis of your record of previous participation, you will be notified by the HUD Office. You may request reconsideration by the HUD Review Committee. Alternatively, you may request a hearing before a Hearing Officer. Either request must be made in writing within 30 days from your receipt of the notice of determination.

If you do request reconsideration by the Review Committee and the reconsideration results in an adverse determination, you may then request a hearing before a Hearing Officer. The Hearing Officer will issue a report to the Review Committee. You will be notified of the final ruling by certified mail.

Specific Line Instructions:

Reason for submitting this Certification: e.g., refinancing, change in ownership, change in management agent, transfer of physical assets, etc.

Block 1: Fill in the name of the agency to which you are applying. For example: HUD Office, Farmers Home Administration District office, or the name of a State or local housing finance agency. Below that, fill in the name of the city where the office is located.

Block 2: Fill in the name of the project, such as "Greenwood Apts." If the name has not yet been selected, write "Name unknown." Below that, enter the HUD contract or project identification number, the Farmers Home Administration project number, or the State or local housing finance agency project or contract number. Include **all** project or contract

identification numbers that are relevant to the project. Also enter the name of the city in which the project is located, and the ZIP Code.

Block 3: Fill in the dollar amount requested in the proposed mortgage, or the annual amount of rental assistance requested.

Block 4: Fill in the number of apartment units proposed, such as "40 units." For hospital projects or nursing homes, fill in the number of beds proposed, such as "100 beds."

Block 5: Fill in the section of the Housing Act under which the application is filed.

Block 7: Definitions of all those who are considered principals and affiliates are given above in the section titled "Who Must Sign and File "

Block 8: Beside the name of each principal, fill in the appropriate role. The following are examples of possible roles that the principals may assume: Owner/Mortgagor, Managing Agent, Sponsor, Developer, General Contractor, Packager, Consultant, Nursing Home Administrator etc.

Block 9 : Fill in the Social Security Number or IRS employer number of every principal listed, including affiliates.

Instructions for Completing Schedule A:

Be sure that Schedule A is filled-in completely, accurately and the certification is properly dated and signed, because it will serve as a legal record of your previous experience. All Multifamily Housing projects involving HUD/ FmHA, and State and local Housing Finance Agencies in which you have previously participated **must be** listed. Applicants are reminded that previous participation pertains to the individual principal within an entity as well as the entity itself. A newly formed company may not have previous participation, but the principals within the company may have had extensive participation and disclosure of that activity is required.

Column 2. All previous projects must be listed or your certification cannot be processed. Include the name of all projects, project number, city where it is located and the governmental agency (HUD, USDA-FmHA or state or local housing finance agency) that was involved.

Column 3. List the role(s) as a principal, dates participated and if fee or identity of interest (IOI) with owners.

Column 4. Indicate the current status of the loan. Except for current loan, the date associated with the status is required. Loans under a workout arrangement are considered assigned. For all noncurrent loans, an explanation of the status is required.

Column 5. Explain any project defaults during your participation.

Column 6. Provide the latest Management Review (MOR) rating and Physical Inspection score.

Certification: After you have completed all other parts of

form HUD-2530, including schedule A, read the Certification carefully. In the box below the statement of the certification, fill in the names of all principals and affiliates as listed in block 7. Each principal should sign the certification with the exception in some cases of individuals associated with a corporation (see "Exception for Corporations" in the section of the instructions titled "Who Must Sign and File Form HUD-2530). Principal who is signing on behalf of the entity should attach signature authority document. Each principal who signs the form should fill in the date of the signature and

a telephone number. By providing a telephone number, HUD can reach you in the event of any questions.

If you cannot certify and sign the certification as it is printed because some statements do not correctly describe your record, use a pen to strike through those parts that differ with your record, and then sign and certify.

Attach a signed statement of explanation of the items you have struck out on the certification. Item 2e. relates to felony convictions within the past 10 years. If you are convicted of

a felony within the past 10 years, strike out 2e. and attach statement of explanation. A felony conviction will not necessarily cause your participation to be disapproved unless there is a criminal record or other evidence that your previous conduct or method of doing business has been such that your participation in the project would make it an unacceptable risk from the underwriting stand point of an insurer, lender or governmental agency.

The Department of Housing and Urban Development (HUD) is authorized to collect this information by law (42 U.S.C. 3535(d) and 24 C.F.R. 200.217) and by regulation at 24 CFR 200.210. This information is needed so that principals applying to participate in multifamily programs can become HUD-approved participants. The information you provide will enable HUD to evaluate your record with respect to established standards of performance, responsibility and eligibility. Without prior approval, a principal may not participate in a proposed or existing multifamily project. HUD uses this information to evaluate whether or not principals pose an unsatisfactory underwriting risk. The information is used to evaluate the potential principals and approve only individuals and organizations that will honor their legal, financial and contractual obligations.

Privacy Act Statement: The Housing and Community Development Act of 1987, 42 U.S.C. 3543 requires persons applying for a Federally-insured or guaranteed loan to furnish his/her Social Security Number (SSN). HUD must have your SSN for identification of your records. HUD may use your SSN for automated processing of your records and to make requests for information about you and your previous records with other public agencies and private sector sources. HUD may disclose certain information to Federal, State and local agencies when relevant to civil, criminal, or regulatory investigations and prosecutions. It will not be otherwise disclosed or released outside of HUD, except as required and permitted by law. You must provide all of the information requested in this application, including your SSN.

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. This agency may not collect this information, and you are not required to complete this form, unless it displays a currently valid OMB control number.

A response is mandatory. Failure to provide any of the information will result in your disapproval of participation in this HUD program.

**U.S. Department of Housing
and Urban Development**

Office of Public and Indian Housing

**Representations, Certifications,
and Other Statements of Bidders
Public and Indian Housing Programs**

Representations, Certifications, and Other Statements of Bidders

Public and Indian Housing Programs

Table of Contents

Clause	Page
1. Certificate of Independent Price Determination	1
2. Contingent Fee Representation and Agreement	1
3. Certification and Disclosure Regarding Payments to Influence Certain Federal Transactions	1
4. Organizational Conflicts of Interest Certification	2
5. Bidder's Certification of Eligibility	2
6. Minimum Bid Acceptance Period	2
7. Small, Minority, Women-Owned Business Concern Representation	2
8. Indian-Owned Economic Enterprise and Indian Organization Representation	2
9. Certification of Eligibility Under the Davis-Bacon Act	3
10. Certification of Nonsegregated Facilities	3
11. Clean Air and Water Certification	3
12. Previous Participation Certificate	3
13. Bidder's Signature	3

1. Certificate of Independent Price Determination

(a) The bidder certifies that--

(1) The prices in this bid have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other bidder or competitor relating to (i) those prices, (ii) the intention to submit a bid, or (iii) the methods or factors used to calculate the prices offered;

(2) The prices in this bid have not been and will not be knowingly disclosed by the bidder, directly or indirectly, to any other bidder or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a competitive proposal solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the bidder to induce any other concern to submit or not to submit a bid for the purpose of restricting competition.

(b) Each signature on the bid is considered to be a certification by the signatory that the signatory--

(1) Is the person in the bidder's organization responsible for determining the prices being offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above; or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above.

[insert full name of person(s) in the bidder's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the bidder's organization];

(ii) As an authorized agent, does certify that the principals named in subdivision (b)(2)(i) above have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above; and

(iii) As an agent, has not personally participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) above.

(c) If the bidder deletes or modifies subparagraph (a)2 above, the bidder must furnish with its bid a signed statement setting forth in detail the circumstances of the disclosure.

[x] [Contracting Officer check if following paragraph is applicable]

(d) Non-collusive affidavit. (applicable to contracts for construction and equipment exceeding \$50,000)

(1) Each bidder shall execute, in the form provided by the PHA/IHA, an affidavit to the effect that he/she has not colluded with any other person, firm or corporation in regard to any bid submitted in response to this solicitation. If the successful bidder did not submit the affidavit with his/her bid, he/she must submit it within three (3) working days of bid opening. Failure to submit the affidavit by that date may render the bid nonresponsive. No contract award will be made without a properly executed affidavit.

(2) A fully executed "Non-collusive Affidavit" [] is, [] is not included with the bid.

2. Contingent Fee Representation and Agreement

(a) Definitions. As used in this provision:

"Bona fide employee" means a person, employed by a bidder and subject to the bidder's supervision and control as to time, place, and manner of performance, who neither exerts, nor proposes to exert improper influence to solicit or obtain contracts nor holds out as being able to obtain any contract(s) through improper influence.

"Improper influence" means any influence that induces or tends to induce a PHA/IHA employee or officer to give consideration or to act regarding a PHA/IHA contract on any basis other than the merits of the matter.

(b) The bidder represents and certifies as part of its bid that, except for full-time bona fide employees working solely for the bidder, the bidder:

(1) [] has, [] has not employed or retained any person or company to solicit or obtain this contract; and

(2) [] has, [] has not paid or agreed to pay to any person or company employed or retained to solicit or obtain this contract any commission, percentage, brokerage, or other fee contingent upon or resulting from the award of this contract.

(c) If the answer to either (a)(1) or (a)(2) above is affirmative, the bidder shall make an immediate and full written disclosure to the PHA/IHA Contracting Officer.

(d) Any misrepresentation by the bidder shall give the PHA/IHA the right to (1) terminate the contract; (2) at its discretion, deduct from contract payments the amount of any commission, percentage, brokerage, or other contingent fee; or (3) take other remedy pursuant to the contract.

3. Certification and Disclosure Regarding Payments to Influence Certain Federal Transactions (applicable to contracts exceeding \$100,000)

(a) The definitions and prohibitions contained in Section 1352 of title 31, United States Code, are hereby incorporated by reference in paragraph (b) of this certification.

(b) The bidder, by signing its bid, hereby certifies to the best of his or her knowledge and belief as of December 23, 1989 that:

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of a contract resulting from this solicitation;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the bidder shall complete and submit, with its bid, OMB standard form LLL, "Disclosure of Lobbying Activities;" and

(3) He or she will include the language of this certification in all subcontracts at any tier and require that all recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.

(c) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision or who fails to file or amend the disclosure form to be filed or amended by this provision, shall be subject to a civil penalty of not less than \$10,000, and not more than \$100,000, for each such failure.

(d) Indian tribes (except those chartered by States) and Indian organizations as defined in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) are exempt from the requirements of this provision.

4. Organizational Conflicts of Interest Certification

The bidder certifies that to the best of its knowledge and belief and except as otherwise disclosed, he or she does not have any organizational conflict of interest which is defined as a situation in which the nature of work to be performed under this proposed contract and the bidder's organizational, financial, contractual, or other interests may, without some restriction on future activities:

(a) Result in an unfair competitive advantage to the bidder; or,

(b) Impair the bidder's objectivity in performing the contract work.

☐ In the absence of any actual or apparent conflict, I hereby certify that to the best of my knowledge and belief, no actual or apparent conflict of interest exists with regard to my possible performance of this procurement.

5. Bidder's Certification of Eligibility

(a) By the submission of this bid, the bidder certifies that to the best of its knowledge and belief, neither it, nor any person or firm which has an interest in the bidder's firm, nor any of the bidder's subcontractors, is ineligible to:

(1) Be awarded contracts by any agency of the United States Government, HUD, or the State in which this contract is to be performed; or,

(2) Participate in HUD programs pursuant to 24 CFR Part 24.

(b) The certification in paragraph (a) above is a material representation of fact upon which reliance was placed when making award. If it is later determined that the bidder knowingly rendered an erroneous certification, the contract may be terminated for default, and the bidder may be debarred or suspended from participation in HUD programs and other Federal contract programs.

6. Minimum Bid Acceptance Period

(a) "Acceptance period," as used in this provision, means the number of calendar days available to the PHA/IHA for awarding a contract from the date specified in this solicitation for receipt of bids.

(b) This provision supersedes any language pertaining to the acceptance period that may appear elsewhere in this solicitation.

(c) The PHA/IHA requires a minimum acceptance period of [Contracting Officer insert time period] calendar days.

(d) In the space provided immediately below, bidders may specify a longer acceptance period than the PHA's/IHA's minimum requirement. The bidder allows the following acceptance period: calendar days.

(e) A bid allowing less than the PHA's/IHA's minimum acceptance period will be rejected.

(f) The bidder agrees to execute all that it has undertaken to do, in compliance with its bid, if that bid is accepted in writing within (1) the acceptance period stated in paragraph (c) above or (2) any longer acceptance period stated in paragraph (d) above.

7. Small, Minority, Women-Owned Business Concern Representation

The bidder represents and certifies as part of its bid/ offer that it --

☐ is, ☐ is not a small business concern. "Small business concern," as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding, and qualified as a small business under the criteria and size standards in 13 CFR 121.

☐ is, ☐ is not a women-owned business enterprise. "Women-owned business enterprise," as used in this provision, means a business that is at least 51 percent owned by a woman or women who are U.S. citizens and who also control and operate the business.

☐ is, ☐ is not a minority business enterprise. "Minority business enterprise," as used in this provision, means a business which is at least 51 percent owned or controlled by one or more minority group members or, in the case of a publicly owned business, at least 51 percent of its voting stock is owned by one or more minority group members, and whose management and daily operations are controlled by one or more such individuals. For the purpose of this definition, minority group members are:

(Check the block applicable to you)

☐ Black Americans

☐ Asian Pacific Americans

☐ Hispanic Americans

☐ Asian Indian Americans

☐ Native Americans

☐ Hasidic Jewish Americans

8. Indian-Owned Economic Enterprise and Indian Organization Representation

(applicable only if this solicitation is for a contract to be performed on a project for an Indian Housing Authority)

The bidder represents and certifies that it:

☐ is, ☐ is not an Indian-owned economic enterprise. "Economic enterprise," as used in this provision, means any commercial, industrial, or business activity established or organized for the purpose of profit, which is at least 51 percent Indian owned. "Indian," as used in this provision, means any person who is a member of any tribe, band, group, pueblo, or community which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs and any "Native" as defined in the Alaska Native Claims Settlement Act.

☐ is, ☐ is not an Indian organization. "Indian organization," as used in this provision, means the governing body of any Indian tribe or entity established or recognized by such governing body. Indian "tribe" means any Indian tribe, band, group, pueblo, or

community including Native villages and Native groups (including corporations organized by Kenai, Juneau, Sitka, and Kodiak) as defined in the Alaska Native Claims Settlement Act, which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs.

9. Certification of Eligibility Under the Davis-Bacon Act (applicable to construction contracts exceeding \$2,000)

(a) By the submission of this bid, the bidder certifies that neither it nor any person or firm who has an interest in the bidder's firm is a person or firm ineligible to be awarded contracts by the United States Government by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(b) No part of the contract resulting from this solicitation shall be subcontracted to any person or firm ineligible to be awarded contracts by the United States Government by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(c) The penalty for making false statements is prescribed in the U. S. Criminal Code, 18 U.S.C. 1001.

10. Certification of Nonsegregated Facilities (applicable to contracts exceeding \$10,000)

(a) The bidder's attention is called to the clause entitled **Equal Employment Opportunity** of the General Conditions of the Contract for Construction.

(b) "Segregated facilities," as used in this provision, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin because of habit, local custom, or otherwise.

(c) By the submission of this bid, the bidder certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The bidder agrees that a breach of this certification is a violation of the Equal Employment Opportunity clause in the contract.

(d) The bidder further agrees that (except where it has obtained identical certifications from proposed subcontractors for specific time periods) prior to entering into subcontracts which exceed \$10,000 and are not exempt from the requirements of the Equal Employment Opportunity clause, it will:

(1) Obtain identical certifications from the proposed subcontractors;

(2) Retain the certifications in its files; and

(3) Forward the following notice to the proposed subcontractors (except if the proposed subcontractors have submitted identical certifications for specific time periods):

Notice to Prospective Subcontractors of Requirement for Certifications of Nonsegregated Facilities

A Certification of Nonsegregated Facilities must be submitted before the award of a subcontract exceeding \$10,000 which is not exempt from the provisions of the Equal Employment Opportunity clause of the prime contract. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

Note: The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

11. Clean Air and Water Certification (applicable to contracts exceeding \$100,000)

The bidder certifies that:

(a) Any facility to be used in the performance of this contract [] is, [] is not listed on the Environmental Protection Agency List of Violating Facilities:

(b) The bidder will immediately notify the PHA/IHA Contracting Officer, before award, of the receipt of any communication from the Administrator, or a designee, of the Environmental Protection Agency, indicating that any facility that the bidder proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities; and,

(c) The bidder will include a certification substantially the same as this certification, including this paragraph (c), in every nonexempt subcontract.

12. Previous Participation Certificate (applicable to construction and equipment contracts exceeding \$50,000)

(a) The bidder shall complete and submit with his/her bid the Form HUD-2530, "Previous Participation Certificate." If the successful bidder does not submit the certificate with his/her bid, he/she must submit it within three (3) working days of bid opening. Failure to submit the certificate by that date may render the bid nonresponsive. No contract award will be made without a properly executed certificate.

(b) A fully executed "Previous Participation Certificate"

[] is, [] is not included with the bid.

13. Bidder's Signature

The bidder hereby certifies that the information contained in these certifications and representations is accurate, complete, and current.

(Signature and Date)

(Typed or Printed Name)

(Title)

(Company Name)

(Company Address)

**U.S. Department of Housing and
Urban Development**
Office of Public and Indian Housing

**Instructions to Bidders for Contracts
Public and Indian Housing Programs**

Instructions to Bidders for Contracts

Public and Indian Housing Programs

Table of Contents

Clause	Page
1. Bid Preparation and Submission	1
2. Explanations and Interpretations to Prospective Bidders	1
3. Amendments to Invitations for Bids	1
4. Responsibility of Prospective Contractor	1
5. Late Submissions, Modifications, and Withdrawal of Bids	1
6. Bid Opening	2
7. Service of Protest	2
8. Contract Award	2
9. Bid Guarantee	3
10. Assurance of Completion	3
11. Preconstruction Conference	3
12. Indian Preference Requirements	3

1. Bid Preparation and Submission

(a) Bidders are expected to examine the specifications, drawings, all instructions, and, if applicable, the construction site (see also the contract clause entitled **Site Investigation and Conditions Affecting the Work** of the *General Conditions of the Contract for Construction*). Failure to do so will be at the bidders' risk.

(b) All bids must be submitted on the forms provided by the Public Housing Agency/Indian Housing Authority (PHA/IHA). Bidders shall furnish all the information required by the solicitation. Bids must be signed and the bidder's name typed or printed on the bid sheet and each continuation sheet which requires the entry of information by the bidder. Erasures or other changes must be initialed by the person signing the bid. Bids signed by an agent shall be accompanied by evidence of that agent's authority. (Bidders should retain a copy of their bid for their records.)

(c) Bidders must submit as part of their bid a completed form HUD-5369-A, "Representations, Certifications, and Other Statements of Bidders."

(d) All bid documents shall be sealed in an envelope which shall be clearly marked with the words "Bid Documents," the Invitation for Bids (IFB) number, any project or other identifying number, the bidder's name, and the date and time for receipt of bids.

(e) If this solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "No Bid" in the space provided for any item on which no price is submitted.

(f) Unless expressly authorized elsewhere in this solicitation, alternate bids will not be considered.

(g) Unless expressly authorized elsewhere in this solicitation, bids submitted by telegraph or facsimile (fax) machines will not be considered.

(h) If the proposed contract is for a Mutual Help project (as described in 24 CFR Part 905, Subpart E) that involves Mutual Help contributions of work, material, or equipment, supplemental information regarding the bid advertisement is provided as an attachment to this solicitation.

2. Explanations and Interpretations to Prospective Bidders

(a) Any prospective bidder desiring an explanation or interpretation of the solicitation, specifications, drawings, etc., must request it at least 7 days before the scheduled time for bid opening. Requests may be oral or written. Oral requests must be confirmed in writing. The only oral clarifications that will be provided will be those clearly related to solicitation procedures, i.e., not substantive technical information. No other oral explanation or interpretation will be provided. Any information given a prospective bidder concerning this solicitation will be furnished promptly to all other prospective bidders as a written amendment to the solicitation, if that information is necessary in submitting bids, or if the lack of it would be prejudicial to other prospective bidders.

(b) Any information obtained by, or provided to, a bidder other than by formal amendment to the solicitation shall not constitute a change to the solicitation.

3. Amendments to Invitations for Bids

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

(b) Bidders shall acknowledge receipt of any amendment to this solicitation (1) by signing and returning the amendment, (2) by identifying the amendment number and date on the bid form, or (3) by letter, telegram, or facsimile, if those methods are authorized in the solicitation. The PHA/IHA must receive acknowledgement by the time and at the place specified for receipt of bids. Bids which fail to acknowledge the bidder's receipt of any amendment will result in the rejection of the bid if the amendment(s) contained information which substantively changed the PHA's/IHA's requirements.

(c) Amendments will be on file in the offices of the PHA/IHA and the Architect at least 7 days before bid opening.

4. Responsibility of Prospective Contractor

(a) The PHA/IHA will award contracts only to responsible prospective contractors who have the ability to perform successfully under the terms and conditions of the proposed contract. In determining the responsibility of a bidder, the PHA/IHA will consider such matters as the bidder's:

- (1) Integrity;
- (2) Compliance with public policy;
- (3) Record of past performance; and
- (4) Financial and technical resources (including construction and technical equipment).

(b) Before a bid is considered for award, the bidder may be requested by the PHA/IHA to submit a statement or other documentation regarding any of the items in paragraph (a) above. Failure by the bidder to provide such additional information shall render the bidder nonresponsible and ineligible for award.

5. Late Submissions, Modifications, and Withdrawal of Bids

(a) Any bid received at the place designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before award is made and it:

(1) Was sent by registered or certified mail not later than the fifth calendar day before the date specified for receipt of offers (e.g., an offer submitted in response to a solicitation requiring receipt of offers by the 20th of the month must have been mailed by the 15th);

(2) Was sent by mail, or if authorized by the solicitation, was sent by telegram or via facsimile, and it is determined by the PHA/IHA that the late receipt was due solely to mishandling by the PHA/IHA after receipt at the PHA/IHA; or

(3) Was sent by U.S. Postal Service Express Mail Next Day Service - Post Office to Addressee, not later than 5:00 p.m. at the place of mailing two working days prior to the date specified for receipt of proposals. The term "working days" excludes weekends and observed holidays.

(b) Any modification or withdrawal of a bid is subject to the same conditions as in paragraph (a) of this provision.

(c) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent either by registered or certified mail is the U.S. or Canadian Postal Service postmark both on the envelope or wrapper and on the original receipt from the U.S. or Canadian Postal Service. Both postmarks must show a legible date and the bid, modification, or withdrawal shall be processed as if mailed late. "Postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed by employees of the U.S. or Canadian Postal Service on the date of mailing. Therefore, bidders should request the postal clerk to place a hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

(d) The only acceptable evidence to establish the time of receipt at the PHA/IHA is the time/date stamp of PHA/IHA on the proposal wrapper or other documentary evidence of receipt maintained by the PHA/IHA.

(e) The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent by Express Mail Next Day Service-Post Office to Addressee is the date entered by the post office receiving clerk on the "Express Mail Next Day Service-Post Office to Addressee" label and the postmark on both the envelope or wrapper and on the original receipt from the U.S. Postal Service. "Postmark" has the same meaning as defined in paragraph (c) of this provision, excluding postmarks of the Canadian Postal Service. Therefore, bidders should request the postal clerk to place a legible hand cancellation bull's eye postmark on both the receipt and Failure by a bidder to acknowledge receipt of the envelope or wrapper.

(f) Notwithstanding paragraph (a) of this provision, a late modification of an otherwise successful bid that makes its terms more favorable to the PHA/IHA will be considered at any time it is received and may be accepted.

(g) Bids may be withdrawn by written notice, or if authorized by this solicitation, by telegram (including mailgram) or facsimile machine transmission received at any time before the exact time set for opening of bids; provided that written confirmation of telegraphic or facsimile withdrawals over the signature of the bidder is mailed and postmarked prior to the specified bid opening time. A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for opening of bids, the identity of the person requesting withdrawal is established and the person signs a receipt for the bid.

6. Bid Opening

All bids received by the date and time of receipt specified in the solicitation will be publicly opened and read. The time and place of opening will be as specified in the solicitation. Bidders and other interested persons may be present.

7. Service of Protest

(a) Definitions. As used in this provision:

"Interested party" means an actual or prospective bidder whose direct economic interest would be affected by the award of the contract.

"Protest" means a written objection by an interested party to this solicitation or to a proposed or actual award of a contract pursuant to this solicitation.

(b) Protests shall be served on the Contracting Officer by obtaining written and dated acknowledgement from —

[Contracting Officer designate the official or location where a protest may be served on the Contracting Officer]

(c) All protests shall be resolved in accordance with the PHA's/IHA's protest policy and procedures, copies of which are maintained at the PHA/IHA.

8. Contract Award

(a) The PHA/IHA will evaluate bids in response to this solicitation without discussions and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the PHA/IHA considering only price and any price-related factors specified in the solicitation.

(b) If the apparent low bid received in response to this solicitation exceeds the PHA's/IHA's available funding for the proposed contract work, the PHA/IHA may either accept separately priced items (see 8(e) below) or use the following procedure to determine contract award. The PHA/IHA shall apply in turn to each bid (proceeding in order from the apparent low bid to the high bid) each of the separately priced bid deductible items, if any, in their priority order set forth in this solicitation. If upon the application of the first deductible item to all initial bids, a new low bid is within the PHA's/IHA's available funding, then award shall be made to that bidder. If no bid is within the available funding amount, then the PHA/IHA shall apply the second deductible item. The PHA/IHA shall continue this process until an evaluated low bid, if any, is within the PHA's/IHA's available funding. If upon the application of all deductibles, no bid is within the PHA's/IHA's available funding, or if the solicitation does not request separately priced deductibles, the PHA/IHA shall follow its written policy and procedures in making any award under this solicitation.

(c) In the case of tie low bids, award shall be made in accordance with the PHA's/IHA's written policy and procedures.

(d) The PHA/IHA may reject any and all bids, accept other than the lowest bid (e.g., the apparent low bid is unreasonably low), and waive informalities or minor irregularities in bids received, in accordance with the PHA's/IHA's written policy and procedures.

(e) Unless precluded elsewhere in the solicitation, the PHA/IHA may accept any item or combination of items bid.

(f) The PHA/IHA may reject any bid as nonresponsive if it is materially unbalanced as to the prices for the various items of work to be performed. A bid is materially unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

(g) A written award shall be furnished to the successful bidder within the period for acceptance specified in the bid and shall result in a binding contract without further action by either party.

9. Bid Guarantee (applicable to construction and equipment contracts exceeding \$25,000)

All bids must be accompanied by a negotiable bid guarantee which shall not be less than five percent (5%) of the amount of the bid. The bid guarantee may be a certified check, bank draft, U.S. Government Bonds at par value, or a bid bond secured by a surety company acceptable to the U.S. Government and authorized to do business in the state where the work is to be performed. In the case where the work under the contract will be performed on an Indian reservation area, the bid guarantee may also be an irrevocable Letter of Credit (see provision 10, Assurance of Completion, below). Certified checks and bank drafts must be made payable to the order of the PHA/IHA. The bid guarantee shall insure the execution of the contract and the furnishing of a method of assurance of completion by the successful bidder as required by the solicitation. Failure to submit a bid guarantee with the bid shall result in the rejection of the bid. Bid guarantees submitted by unsuccessful bidders will be returned as soon as practicable after bid opening.

10. Assurance of Completion

(a) Unless otherwise provided in State law, the successful bidder shall furnish an assurance of completion prior to the execution of any contract under this solicitation. This assurance may be [Contracting Officer check applicable items] —

[] (1) a performance and payment bond in a penal sum of 100 percent of the contract price; or, as may be required or permitted by State law;

[] (2) separate performance and payment bonds, each for 50 percent or more of the contract price;

[] (3) a 20 percent cash escrow;

[] (4) a 25 percent irrevocable letter of credit; or,

[] (5) an irrevocable letter of credit for 10 percent of the total contract price with a monitoring and disbursements agreement with the IHA (applicable only to contracts awarded by an IHA under the Indian Housing Program).

(b) Bonds must be obtained from guarantee or surety companies acceptable to the U.S. Government and authorized to do business in the state where the work is to be performed. Individual sureties will not be considered. U.S. Treasury Circular Number 570, published annually in the Federal Register, lists companies approved to act as sureties on bonds securing Government contracts, the maximum underwriting limits on each contract bonded, and the States in which the company is licensed to do business. Use of companies listed in this circular is mandatory. Copies of the circular may be downloaded on the U.S. Department of Treasury website <http://www.fms.treas.gov/c570/index.html>, or ordered for a minimum fee by contacting the Government Printing Office at (202) 512-2168.

(c) Each bond shall clearly state the rate of premium and the total amount of premium charged. The current power of attorney for the person who signs for the surety company must be attached to the bond. The effective date of the power of attorney shall not precede the date of the bond. The effective date of the bond shall be on or after the execution date of the contract.

(d) Failure by the successful bidder to obtain the required assurance of completion within the time specified, or within such extended period as the PHA/IHA may grant based upon reasons determined adequate by the PHA/IHA, shall render the bidder ineligible for award. The PHA/IHA may then either award the contract to the next lowest responsible bidder or solicit new bids. The PHA/IHA may retain the ineligible bidder's bid guarantee.

11. Preconstruction Conference (applicable to construction contracts)

After award of a contract under this solicitation and prior to the start of work, the successful bidder will be required to attend a preconstruction conference with representatives of the PHA/IHA and its architect/engineer, and other interested parties convened by the PHA/IHA. The conference will serve to acquaint the participants with the general plan of the construction operation and all other requirements of the contract (e.g., Equal Employment Opportunity, Labor Standards). The PHA/IHA will provide the successful bidder with the date, time, and place of the conference.

12. Indian Preference Requirements (applicable only if this solicitation is for a contract to be performed on a project for an Indian Housing Authority)

(a) HUD has determined that the contract awarded under this solicitation is subject to the requirements of section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450e(b)). Section 7(b) requires that any contract or subcontract entered into for the benefit of Indians shall require that, to the greatest extent feasible

(1) Preferences and opportunities for training and employment (other than core crew positions; see paragraph (h) below) in connection with the administration of such contracts or subcontracts be given to qualified "Indians." The Act defines "Indians" to mean persons who are members of an Indian tribe and defines "Indian tribe" to mean any Indian tribe, band, nation, or other organized group or community, including any Alaska Native village or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act, which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians; and,

(2) Preference in the award of contracts or subcontracts in connection with the administration of contracts be given to Indian organizations and to Indian-owned economic enterprises, as defined in section 3 of the Indian Financing Act of 1974 (25 U.S.C. 1452). That Act defines "economic enterprise" to mean any Indian-owned commercial, industrial, or business activity established or organized for the purpose of profit, except that the Indian ownership must constitute not less than 51 percent of the enterprise; "Indian organization" to mean the governing body of any Indian tribe or entity established or recognized by such governing body; "Indian" to mean any person who is a member of any tribe, band, group, pueblo, or community which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs and any "Native" as defined in the Alaska Native Claims Settlement Act; and Indian "tribe" to mean any Indian tribe, band, group, pueblo, or community including Native villages and Native groups (including

corporations organized by Kenai, Juneau, Sitka, and Kodiak) as defined in the Alaska Native Claims Settlement Act, which is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs.

(b) (1) The successful Contractor under this solicitation shall comply with the requirements of this provision in awarding all subcontracts under the contract and in providing training and employment opportunities.

(2) A finding by the IHA that the contractor, either (i) awarded a subcontract without using the procedure required by the IHA, (ii) falsely represented that subcontracts would be awarded to Indian enterprises or organizations; or, (iii) failed to comply with the contractor's employment and training preference bid statement shall be grounds for termination of the contract or for the assessment of penalties or other remedies.

(c) If specified elsewhere in this solicitation, the IHA may restrict the solicitation to qualified Indian-owned enterprises and Indian organizations. If two or more (or a greater number as specified elsewhere in the solicitation) qualified Indian-owned enterprises or organizations submit responsive bids, award shall be made to the qualified enterprise or organization with the lowest responsive bid. If fewer than the minimum required number of qualified Indian-owned enterprises or organizations submit responsive bids, the IHA shall reject all bids and readvertise the solicitation in accordance with paragraph (d) below.

(d) If the IHA prefers not to restrict the solicitation as described in paragraph (c) above, or if after having restricted a solicitation an insufficient number of qualified Indian enterprises or organizations submit bids, the IHA may advertise for bids from non-Indian as well as Indian-owned enterprises and Indian organizations. Award shall be made to the qualified Indian enterprise or organization with the lowest responsive bid if that bid is -

(1) Within the maximum HUD-approved budget amount established for the specific project or activity for which bids are being solicited; and

(2) No more than the percentage specified in 24 CFR 905.175(c) higher than the total bid price of the lowest responsive bid from any qualified bidder. If no responsive bid by a qualified Indian-owned economic enterprise or organization is within the stated range of the total bid price of the lowest responsive bid from any qualified enterprise, award shall be made to the bidder with the lowest bid.

(e) Bidders seeking to qualify for preference in contracting or subcontracting shall submit proof of Indian ownership with their bids. Proof of Indian ownership shall include but not be limited to:

(1) Certification by a tribe or other evidence that the bidder is an Indian. The IHA shall accept the certification of a tribe that an individual is a member.

(2) Evidence such as stock ownership, structure, management, control, financing and salary or profit sharing arrangements of the enterprise.

(f) (1) All bidders must submit with their bids a statement describing how they will provide Indian preference in the award of subcontracts. The specific requirements of that statement and the factors to be used by the IHA in determining the statement's adequacy are included as an attachment to this solicitation. Any bid that fails to include the required statement shall be rejected as nonresponsive. The IHA may require that comparable statements be provided by subcontractors to the successful Contractor, and may require the Contractor to reject any bid or proposal by a subcontractor that fails to include the statement.

(2) Bidders and prospective subcontractors shall submit a certification (supported by credible evidence) to the IHA in any instance where the bidder or subcontractor believes it is infeasible to provide Indian preference in subcontracting. The acceptance or rejection by the IHA of the certification shall be final. Rejection shall disqualify the bid from further consideration.

(g) All bidders must submit with their bids a statement detailing their employment and training opportunities and their plans to provide preference to Indians in implementing the contract; and the number or percentage of Indians anticipated to be employed and trained. Comparable statements from all proposed subcontractors must be submitted. The criteria to be used by the IHA in determining the statement(s)'s adequacy are included as an attachment to this solicitation. Any bid that fails to include the required statement(s), or that includes a statement that does not meet minimum standards required by the IHA shall be rejected as nonresponsive.

(h) Core crew employees. A core crew employee is an individual who is a bona fide employee of the contractor at the time the bid is submitted; or an individual who was not employed by the bidder at the time the bid was submitted, but who is regularly employed by the bidder in a supervisory or other key skilled position when work is available. Bidders shall submit with their bids a list of all core crew employees.

(i) Preference in contracting, subcontracting, employment, and training shall apply not only on-site, on the reservation, or within the IHA's jurisdiction, but also to contracts with firms that operate outside these areas (e.g., employment in modular or manufactured housing construction facilities).

(j) Bidders should contact the IHA to determine if any additional local preference requirements are applicable to this solicitation.

(k) The IHA [] does [] does not [Contracting Officer check applicable box] maintain lists of Indian-owned economic enterprises and Indian organizations by specialty (e.g., plumbing, electrical, foundations), which are available to bidders to assist them in meeting their responsibility to provide preference in connection with the administration of contracts and subcontracts.



REQUEST FOR BIDS SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

These conditions are a supplement to the HUD 5369 Instructions to Bidders and provide information to help clarify articles of that document. Any articles or paragraphs not specifically mentioned shall remain as printed in HUD 5369 without change.

1. Add to Paragraph 1, subparagraph b:
 - i. The bid documents required for the complete bid package shall consist of the following (all shall be signed originals):
 1. Bid Form
 2. Bid Bond
 3. Non-Collusive Affidavit
 4. Disclosure of Lobbying Activities
 5. Form HUD-2530
 6. Form HUD-5369A
2. Add to paragraph 2 subparagraph a
 - a. All questions are to be received in writing. Oral questions will not be accepted. Oral clarifications will not be provided.
 - b. Responses to all written questions will be posted as addendum on the CMHA website at www.cintimha.com.
3. Add to paragraph 4 subparagraph b.1.
 - b.1 Bidders shall indicate receipt of addendum on Bid Form. No other acknowledgement is required.
4. Add to paragraph 4, subparagraph a:
 - a. Ability to demonstrate a minimum of 7 years of experience as a general contractor, performing work of like scope and material, for the period immediately preceding commencement of this CMHA Project for work of the size and type of this CMHA Project.



REQUEST FOR BIDS SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

CMHA, in its sole and absolute discretion, will consider a request for a waiver of the 7 years of experience requirement, if the contractor can establish that it has successfully undertaken and completed such a number of projects of similar scope and complexity in a lesser number of years so as to confer upon that contractor the same or more experience as other bidders have achieved in 7 or more years of experience.

5. Add to paragraph 5, subparagraph g:

- g. No bid shall be withdrawn for a time period of 335 calendar days from the bid opening. The foregoing limitation upon withdrawal of bids prior to opening shall be subject to the right of withdrawal of a bid made in error as provided by Section 9.31, Ohio Revised Code, to the extent that such statutory provision is applicable.

6. Add to paragraph 10, subparagraphs a, and b:

- a. All bid bonds shall be issued by Surety Companies licensed to issue bonds in the State of Ohio and listed in Federal Register Circular #570. The current power of attorney for the person who signs for any surety company shall be attached to such bid bond.
- b. The CMHA will have the right to retain the bid security of bidders to whom an award is being considered until either (a) the contract has been executed and bonds, if required, have been executed, (b) the specified time has elapsed so that bids may be withdrawn, or (c) all bids have been rejected.

7. Add paragraph 13. Minority Business Enterprise:

It is the goal of CMHA to obtain 20 percent minority business participation on this project.

8. Add paragraph 14. Lead Based Paint:

Any contractor awarded a contract for modernization shall comply with 24 CFR (Code of Federal Regulations) Part 35 prohibiting the use of lead-based paint.



REQUEST FOR BIDS SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

9. Add paragraph 15. Sales Tax Exemption:

The contractor shall take whatever steps required by law to relieve the owner from payment of excise tax and Ohio sales tax on materials, specialties and equipment for contractor to take any part of such action shall constitute the responsibility of the contractor to make such tax payments as within the scope of this contract. The owner is tax exempt, and upon request will provide a statement to that effect.

10. Add paragraph 16. Liquidated Damages

This project has liquidated damages, as specified in Clause 33 of HUD General Conditions in this contract, which may be charged against contractors who do not complete work on time.

11. Add paragraph 17. Pre-Bid Conference

A pre-bid conference for all prospective contractors will be held as indicated on the Invitation of Bids. Questions will not be received or answered at the pre-bid conference. All questions are to be submitted in writing and responses will be posted as addendum to the CMHA website at www.cintimha.com.

Before presenting a bid, the contractor is advised to have visited the site and be thoroughly familiar with the scope of work and the conditions under which it will be executed. Failure to do so will not release contractor of his obligation to furnish all material and labor necessary to carry out all provisions of the contract.

Add paragraph 18. Definition

Addenda are written or graphic instruments issued by the CMHA prior to the execution of the Contract, which modify or interpret the Bidding Documents by additions, deletions, clarifications or corrections.

A Bid is a complete and properly signed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.



REQUEST FOR BIDS SUPPLEMENTAL INSTRUCTIONS TO BIDDERS

The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be in Alternate Bids.

An Alternate Bid or Alternate is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted. Any alternates accepted by the owner shall be accepted in the order in which they are listed in the form of Bid.

A Unit Price is an amount stated in the Bid as a price per unit of measure for materials, equipment or services or a portion of the Work as described in the Bidding Documents, and to be utilized at CMHA's sole discretion.

12. Add paragraph 19. Form and Style of Bids

- a. Bids shall be submitted on the form included in the Bidding Documents.
- b. All blanks on the Bid Form shall be filled in by typewriter or manually in ink.
- c. Where so indicated by the makeup of the Bid Form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the amount written in words shall govern.
- d. The signer of the Bid must initial interlineations, alterations and erasures.
- e. All requested Alternates shall be bid. If no change in the Base Bid is required, enter "No Change."
- f. Each copy of the Bid shall include the legal name of the Bidder and a statement that the Bidder is a sole proprietor, partnership, corporation or other legal entity. Each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation. A Bid submitted by an agent shall have a current power of attorney attached certifying the agent's authority to bind the Bidder.

END OF SECTION



**INVITATION FOR QUOTES
CONSTRUCTION CONTRACT SAMPLE**

**[INTENTIONALLY LEFT BLANK]
REFER TO APPENDIX A AT THE END OF
THIS SECTION FOR CONTRACT SAMPLE**



**INVITATION FOR QUOTES
CONSTRUCTION CONTRACT SAMPLE**

**[INTENTIONALLY LEFT BLANK]
REFER TO APPENDIX A AT THE END OF
THIS SECTION FOR CONTRACT SAMPLE**



**INVITATION FOR QUOTES
CONSTRUCTION CONTRACT SAMPLE**

**[INTENTIONALLY LEFT BLANK]
REFER TO APPENDIX A AT THE END OF
THIS SECTION FOR CONTRACT SAMPLE**



INVITATION FOR BIDS CONSTRUCTION GENERAL TERMS AND CONDITIONS

1.	ARTICLE I CONTRACTOR'S RESPONSIBILITIES.....	1
1.21.	Emergency	3
2.	ARTICLE II HOUSING AUTHORITY RIGHTS AND RESPONSIBILITIES	4
3.	ARTICLE III A/E'S DUTY, RESPONSIBILITY AND AUTHORITY	5
3.3.	Site Visits and Observation	5
3.4.	Testing and Inspection Services	5
3.5.	A/E Review and Approval of Work.....	5
3.6.	Limitation of A/E's Authority	6
4.	ARTICLE IV PRECONSTRUCTION ACTIVITIES	7
4.1.	Pre-construction Conference.....	7
4.2.	Certificate of Insurance.....	7
4.3.	Building and Trade Permits, Licenses and Codes	7
4.4.	Plan Approval and Permits.....	7
4.5.	Trade Permits and Licenses.....	7
5.	ARTICLE V CONSTRUCTION REQUIREMENTS.....	9
5.1.	Commencement of Work on Site.....	9
5.2.	Environmental Controls	9
5.3.	Construction Procedures	9
5.4.	Utilities	10
5.5.	Construction Supervision	12
5.6.	Construction Progress Schedule	12
5.7.	Progress Meetings	14
5.8.	Project Coordination.....	15
5.9.	Additional Tests and Inspections	15
5.10.	Review of Contract Documents	15
5.11.	Site Investigation and Conditions Affecting the Work.....	16
5.12.	Protection of the Project.....	16
5.13.	General Warranty - Materials, Equipment and Workmanship	18
5.14.	Specifications and Drawings for Construction	21
5.15.	As Built Drawings	22
5.16.	Project Document Maintenance and Submittal	22
5.17.	Temporary Buildings and Transportation of Materials.....	23
5.18.	Facilities	23
5.19.	Progress Cleaning.....	23
5.20.	Use of Premises.....	24
5.21.	Smoking and Tobacco Products	24
5.22.	Correction of the Work	25
6.	ARTICLE VI SUBCONTRACTORS.....	27
6.1.	Evaluation and Approval	27
6.2.	Suspension/Debarment	27
6.3.	Contractor's Responsibility	27
6.4.	Mandatory Contract Provisions/Forms.....	27
6.5.	Replacement of Subcontractors	27
6.6.	Contingent Assignment of Subcontract	27
6.7.	Prompt Payment of Subcontracts.....	28
6.8.	Subcontracting with Small and Minority Firms, Women's Business Enterprise, and Labor Surplus Area Firms.....	28
7.	ARTICLE VII PAYMENTS.....	30
7.1.	CMHA Obligation	30



INVITATION FOR BIDS
CONSTRUCTION GENERAL TERMS AND CONDITIONS

7.2.	Forms	30
7.3.	Step One – Pencil Application	30
7.4.	Progress Payments.....	30
7.5.	Allowances	31
7.6.	Unit Prices	31
7.7.	Schedule of Values	31
7.8.	Labor Payments/Retainage.....	32
7.9.	Material Payments/Retainage	32
7.10.	Payments Withheld.....	32
7.11.	Payment Request.....	32
8.	ARTICLE VIII CONTRACT MODIFICATIONS	34
8.1.	Changes in the Work.....	34
8.2.	Change Order	34
8.3.	Change Order Directive.....	34
8.4.	Change Order Procedure	35
8.5.	Change Order Proposal	35
8.6.	Differing Site Conditions	36
8.7.	Minor Changes in the Work	36
8.8.	Change Order Cost or Credit Determination	37
8.9.	Time Extension.....	40
9.	ARTICLE IX CONSTRUCTION CLOSEOUT	41
9.1.	Final Cleaning.....	41
9.2.	Inspection and Construction of the Work.....	41
9.3.	Routine Inspections	41
9.4.	Substantial Completion.....	42
9.5.	Demonstration and Training, Operating Appurtenances	43
9.6.	Acceptance of Defective Work	43
9.7.	Building Commissioning.....	44
9.8.	Contract Completion.....	44
10.	ARTICLE X SUSPENSION AND TERMINATION	45
10.1.	Suspension of the Work.....	45
10.2.	Termination for Convenience	45
10.3.	Termination for Cause/Default	47
10.4.	Contractor Insolvency	48
11.	ARTICLE XI DISPUTE RESOLUTION/CLAIM PROCEDURE	50
11.1.	General.....	50
11.2.	Initiation of a Claim	50
11.3.	Substantiation of Claims General.....	50
11.4.	Substantiation of Claims for increase of the Contract Sum	51
11.5.	Substantiation of Claims for Extension of the Contract Time.....	51
11.6.	Certification of a Claim.....	51
11.7.	Delay and Delay Damage Limitations	51
11.8.	Derivative Claims	52
11.9.	Claim Decision.....	52
11.10.	Audit of a Claim	52
11.11.	False Certification of a Claim	53
12.	ARTICLE XII WARRANTY.....	54
12.1.	Warranty of Title	54
12.2.	Warranty of Construction	54



INVITATION FOR BIDS
CONSTRUCTION GENERAL TERMS AND CONDITIONS

12.3.	Warranty Walk-through Contractor	54
13.	ARTICLE XIII BONDS	55
13.1.	Bid Bond/Guaranty	55
13.2.	Payment and Performance Bond	55
14.	ARTICLE XIV INSURANCE	56
14.1.	Contractor's General Insurance Requirements	56
14.2.	Minimum Coverage Requirements	56
14.3.	Waivers of Subrogation	58
15.	ARTICLE XV INDEMNIFICATION	59
16.	ARTICLE XVI DAMAGES.....	60
16.1.	Liquidated Damages.....	60
16.2.	Mutual Waiver of Consequential Damages	61
17.	ARTICLE XVII EQUAL OPPORTUNITY.....	62
17.1.	Prohibition Against Discrimination	62
18.	ARTICLE XVIII SECTION 3.....	64
18.8.	Section 3 Reporting Requirements	64
19.	ARTICLE XIX LABOR STANDARDS.....	65
19.1.	Compliance with Davis Bacon and Related Acts requirements	65
19.2.	Minimum Wages.....	65
19.3.	Withholding of Funds.....	66
19.4.	Payrolls and Basic Records.....	66
19.5.	Apprentices & Trainees.....	67
19.6.	Compliance with Copeland Act requirements	69
19.7.	Contract Termination; Debarment	69
19.8.	Disputes Concerning Labor Standards	69
19.9.	Certification of Eligibility	69
19.10.	Contract Work Hours and Safety Standards Act	69
19.11.	Subcontracts	69
19.12.	Non-Federal Prevailing Wage Rates.....	700
20.	ARTICLE XX HEALTH, SAFETY AND ACCIDENT PREVENTION	71
20.1.	General Contractor Requirements.....	71
20.2.	Notification of Non-Compliance Procedure.....	71
20.3.	Safety Plan	71
20.4.	Safety Data Sheets	71
20.5.	Hazardous Materials	72
20.6.	Fires or Hot-Work	72
20.7.	Explosives and Blasting	72
21.	ARTICLE XXI CONTRACT DOCUMENTS AND CONTRACT RECORDS.....	73
21.1.	Examination and Retention of Contractor's Records	73
21.2.	Examination and Audit of Contractor's Records.....	73
21.3.	Ownership of Contract Documents	74
21.4.	Intent of Contract Documents	74
21.5.	Use of Electronic Files	74
21.6.	Order of Precedence	74
22.	ARTICLE XXII MISCELLANEOUS	76
22.1.	Assignment	76
22.2.	Contractor Performance Evaluation	76

22.3.	Prohibition Against Liens	76
22.4.	Conflict of Interest	76
22.5.	Limitation on Payments Made to Influence Certain Federal Financial Transactions.....	76
22.6.	Procurement of Recovered Materials.....	77
22.7.	Royalties and Patents.....	77
22.8.	Contract Period	77
22.9.	Other Contracts.....	77
22.10.	Drug-Free Workplace.....	78
22.11.	Energy Efficiency and Sustainability Requirements.....	78
22.12.	Clean Air and Water	78
22.13.	Public Relations.....	78
22.14.	Governing Law	78
22.15.	Written Notice	78
22.16.	Taxes	78
22.17.	Computing Time.....	78
22.18.	Time is of the Essence.....	79
22.19.	Extent of Contract.....	79
22.20.	Severability	79
22.21.	Facsimile/Electronic Mail Signature.....	79
22.22.	No Third Party Interest	79
22.23.	No Waiver	79
22.24.	Assignment of Antitrust Claims	79
22.25.	Survival of Obligations	80
22.26.	Force Majeur.....	80
22.27.	Privacy.....	80
22.28.	Contractor Status	80
23.	ARTICLE XXIII DEFINITIONS AND TERMINOLOGY	81

1. ARTICLE I CONTRACTOR'S RESPONSIBILITIES

- 1.1.** The Contractor shall perform the Work in a workmanlike manner, consistent with the standards of skill and care exercised by entities licensed to perform (where required by Applicable Law) and regularly performing comparable work in the same or similar locality under the same or similar circumstances.
 - 1.1.1.** Furthermore, Contractor agrees to adhere to CMHA's quality standards as outlined in the Contract Documents; this includes, but is not necessary limited to, CMHA's Gold Standards of performance.
- 1.2.** The Contractor shall perform the Work in accordance with the Contract Documents.
- 1.3.** The Contractor shall furnish all labor, services, materials, tools, equipment, superintendence, and transportation necessary for performance of the Work.
 - 1.3.1.** Contractor shall also furnish all necessary water, heat, light, and power not made available to the Contractor by CMHA.
- 1.4.** The Contractor shall perform on the site and with its own organization, work equivalent to at least {12%} (unless otherwise indicated) of the total amount of work to be performed under the order.
 - 1.4.1.** This percentage may reduce by a supplemental agreement to this Construction Contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be the advantage of CMHA.
- 1.5.** At all times during performance of this Construction Contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the work site a competent superintendent whose qualifications and experience are satisfactory to CMHA and has authority to act on behalf of the Contractor.
- 1.6.** The Contractor shall be responsible for all damages, including, but not limited to, damages to persons or property, that occur as a result of the Contractor's breach of this Construction Contract, fault or negligence.
 - 1.6.1.** The Contractor shall take proper safety and health precautions to protect the Work, the workers, the public, and the property of others.
 - 1.6.2.** The Contractor shall hold and save CMHA, including CMHA's officers, employees, consultants, and agents, free and harmless from damages, claims, demands, suits and liabilities of any nature, including but not limited to, all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, caused by the Contractor's breach of this Construction Contract, fault, negligence or performance of the Work.
 - 1.6.3.** The Contractor shall also be responsible for all storage, protection and cleaning of materials delivered and Work performed on the Project, until Contract Completion and acceptance of the entire Project by CMHA, except for any completed unit of Work which may have not been accepted under the Construction Contract.
- 1.7.** The Contractor shall lay out the work from base lines and bench marks indicated in the drawings and be responsible for all lines, levels, and measurements of all work executed under the Contract Documents.
 - 1.7.1.** The Contractor shall verify the lines, bench marks, figures and dimensions indicated in the Contract Documents before laying out the work and will be held responsible for any resulting errors resulting from its failure to do so.
- 1.8.** The Contractor shall confine all operations (including storage of materials) on CMHA's premises to areas authorized or approved by the Contracting Officer.
- 1.9.** The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials.
 - 1.9.1.** After completing the Work and before final inspection, the Contractor shall:
 - A.** Remove from the premises all scaffolding, equipment, tools, materials (including rejected materials) that are not the property of CMHA and rubbish caused by its work;
 - B.** Leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer;
 - C.** Perform all specified tests; and
 - D.** Deliver the installation in complete and operating conditions.
- 1.10.** The Contractor must perform the Work so as to not interfere with, disturb, hinder, or delay the services of separate consultants or the work of separate contractors.

- 1.10.1.** The Contractor must cooperate and coordinate fully with all separate consultants and separate contractors and must freely share all of the Contractor's Project-related information with them to facilitate the timely and proper performance of the Work and of the services and work of the separate consultants and separate contractors.
- 1.10.2.** The Contractor must afford every separate consultant and separate Contractor proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of their services and work.
- 1.10.3.** If the Contractor damages the property or work of any separate consultant or separate Contractor caused by Contractor or by failure to perform the Work with due diligence, delays, interferes with, hinders, or disrupts the services of any separate consultant or separate Contractor who suffers additional expense and damage as a result, the Contractor is responsible for that damage, injury, or expense.
- 1.10.4.** The intent of 1.10 is to benefit any separate consultants and separate contractors and to demonstrate that the separate consultants or separate contractors are intended third-party beneficiaries of Contractor's obligations under the Contract.
- 1.11.** If the proper execution or result of any part of the Work depends upon work performed or services provided by CMHA, a separate consultant, or a separate Contractor, the Contractor must inspect that other work and appropriate instruments of service, and promptly report to CMHA in writing any defects or deficiencies in that other work or services that render it unavailable or unsuitable for the proper execution and results of the Work.
 - 1.11.1.** The Contractor's failure to inspect and promptly report any issues in writing will constitute an acceptance of the other work and services as fit and proper for integration with the Contractor's Work unless in the opinion of CMHA's Project Manager and/or Construction Contract Administrator the defects and deficiencies in the other work and appropriate instruments of service were not reasonably discoverable at the time of the Contractor's inspection.
- 1.12.** The Contractor shall not delay the Work on account of any claim, dispute, or action between the Contractor and CMHA or the Contractor a Separate Consultant or Separate Contractor.
- 1.13.** The Contractor shall complete all portions of Work in the sequence in the Construction Progress Schedule.
- 1.14.** The Contractor shall develop and keep a Construction Progress Schedule and prepare and keep current a schedule of submittals that is coordinated with the Construction Progress Schedule for CMHA's acceptance.
- 1.15.** The Project's regular work hours shall be between 8:00 am and 5:00 pm, or as determined and approved by CMHA.
 - 1.15.1.** The Contractor may modify the regular work hours only if Contractor receives written authorization from CMHA's Project Manager and/or Construction Contract Administrator.
- 1.16.** The Contractor shall coordinate the Work with the activities and responsibilities of the Project's architect or engineer ("A/E"), CMHA and Contractor's surety to meet the contractual dates for Substantial Completion and Contract Completion.
- 1.17.** The Contractor shall remove any snow and ice as may be required for reasonably safe access to the Project, including, without limitation, building entries, driveways, parking lots, and sidewalks.
- 1.18.** The Contractor shall keep a daily log containing a record of weather, number of workers on Site for the Contractor, identification of equipment, Work accomplished, problems encountered and other similar relevant data.
- 1.19.** The Contractor hereby represents and agrees that, prior to submitting its bid or quote to perform the Work on the Project, it has had a competent person carefully and diligently review each part of the Contract Documents, including the Divisions of the Specifications and parts of the Drawings that are not directly applicable to the Work.
 - 1.19.1.** Contractor further represents and agrees that, based upon its careful and diligent review of the Contract Documents, that it is not aware of any conflicts, inconsistencies, errors, or omissions in the Contract Documents for which it has not notified CMHA or the A/E.
 - 1.19.2.** If there are any such conflicts, inconsistencies, errors, or omissions in the Contract Documents, the Contractor will:
 - A.** Provide the labor, equipment, or materials of the better quality or greater quantity of Work; and/or
 - B.** Comply with the more stringent requirements.

- 1.19.3.** The Contractor will not be entitled to any additional compensation for any conflicts, inconsistencies, errors, or omissions that would have been discovered by such careful and diligent review.
- 1.20.** The Contractor hereby represents and agrees that the Project is a public project involving public funds.
- 1.20.1.** The Contractor further understands that CMHA expects and requires that each Contractor adhere to the highest ethical and performance standards.
- 1.20.2.** Accordingly, Contractor hereby pledges and agrees that:
- A.** It will act at all times with absolute integrity and truthfulness in its dealings with CMHA and the A/E;
 - B.** It will use its best efforts to cooperate with CMHA and the A/E and all other contractors and consultants on the Project and at all times will act with professionalism and dignity in its dealings with CMHA, the A/E, and other contractors;
 - C.** It will assign only competent supervisors and workers to the Project, each of whom is fully qualified to perform the tasks that are assigned to him/her; and
 - D.** It has read, understands and will comply with the terms of the Contract Documents.
- 1.21. Emergency**
- 1.21.1.** In the event of an emergency affecting the safety of the Project, other property, or individuals, the Contractor, without special instructions or authorization, shall act to prevent the threatened damage, injury, or loss.
- 1.21.2.** If the Contractor believes that it is entitled to an adjustment of the Contract Sum or Contract Times, or both, on account of its actions in response to any emergency, the Contractor may request a Change Order by giving written notice no later than 48-hours after the emergency.

2. ARTICLE II HOUSING AUTHORITY RIGHTS AND RESPONSIBILITIES

- 2.1. CMHA shall designate a Project Manager and/or Construction Contract Administrator for the Project.
- 2.2. CMHA shall have access to the Work and Site at all times, whether the Project is in preparation or progress.
- 2.3. CMHA is not responsible for construction means, methods, manners, techniques, sequences, procedures, or for safety precautions and programs in connection with the Work, or for the Contractor's failure to carry out the Work in conformity with the Contract Documents.
- 2.4. Upon the date indicated in the Notice to Proceed, CMHA shall provide the Site to the Contractor in a condition to permit the Contractor to perform the Work.
 - 2.4.1. If the Site provided by CMHA is not in a condition to permit the Contractor to perform the Work, Contractor shall notify CMHA's Project Manager and/or Construction Contract Administrator within 48 hours of the Notice to Proceed and identify the conditions which are preventing Contractor from performing the Work.

3. ARTICLE III A/E'S DUTY, RESPONSIBILITY AND AUTHORITY

- 3.1.** The A/E for this Contract and any successor shall be designated in writing by CMHA.
- 3.2.** The A/E's duties and responsibilities may include, but shall not be limited to:
- 3.2.1.** Attend and conduct the Construction Progress Meetings.
 - 3.2.2.** Making periodic visits to the work site and on the basis of his/her on-site inspections, issuing written reports to CMHA which shall include all observed deficiencies.
 - A.** The A/E shall electronically send a copy of the report to CMHA and to the Contractor's designated representative at the site.
 - 3.2.3.** Making modifications in drawings and technical specifications and assisting the Contracting Officer in the preparation of Change Orders and other Contract Modifications for issuance to the Contracting Officer.
 - 3.2.4.** The A/E may authorize minor changes or alterations in the Work that are consistent with the intent of the Contract Documents and do not involve adjustment of the Contract Sum or Contract Times, or both.
 - A.** The A/E has no authority to authorize the Contractor to perform additional or extra Work for which the Contractor may seek adjustment of the Contract Sum or the Contract Time, or both.
 - 3.2.5.** Reviewing and making recommendations with respect to:
 - A.** The Contractor's Construction Progress Schedules;
 - B.** The Contractor's shop and detailed drawings; and
 - C.** The Contractor's price breakdown and progress payment estimates-
 - 3.2.6.** Assisting in inspections, signing Certificates of Substantial Completion and Contract Completion, and making recommendations with respect to acceptance of work completed under the Contract; and
 - 3.2.7.** Approve or certify applicable forms required under the Contract Documents.
- 3.3. Site Visits and Observation**
- 3.3.1.** The A/E shall notify, advise, and consult with CMHA and protect CMHA against Defective Work throughout completion of the Project, which includes the Correction Period, and for such time period CMHA may extend A/E's services.
 - A.** The A/E should designate a field representative, subject to CMHA's approval, to attend meetings, to observe and check the progress and quality of the Work, and to take action as necessary or appropriate to achieve conformity with the Contract Documents.
 - B.** The A/E shall have its consultants attend to the Project at intervals required by its agreement or required by CMHA.
 - 3.3.2.** The A/E is authorized to disapprove or reject Defective Work. The A/E shall immediately notify CMHA any time the A/E disapproves or rejects an item of Work.
 - 3.3.3.** The A/E is not responsible for construction means, methods, manners, techniques, sequences, procedures, or for work safety precautions and programs in connection with the Work, or for the Contractor's failure to carry out the Work in conformity with the Contract Documents.
- 3.4. Testing and Inspection Services**
- 3.4.1.** Unless otherwise specified in the Contract Documents, CMHA shall apply for, secure, and pay for the costs of structural testing and special inspections under the Ohio Building Code; testing including geotechnical analysis, environmental testing and analysis, concrete, masonry, structural steel, reinforcing steel, welding, bolts, steel connections, HVAC systems and controls, plumbing and piping, air, and water balancing and testing, or other testing, or approvals required by Applicable Law.
- 3.5. A/E Review and Approval of Work**
- 3.5.1.** Any information the Contractor submits to the A/E is for the sole purpose of determining whether the Work and information is generally consistent with the Contract's intent, and will not relieve the Contractor of its sole responsibility for the performance, preparation, completeness, and accuracy of the Work and information.
 - 3.5.2.** By reviewing information submitted by the Contractor, A/E is not taking on responsibility for construction means, methods, manners, techniques, sequences, procedures, or for work safety precautions and programs in connection with the Work.
- 3.6. Limitation of A/E's Authority**

- 3.6.1.** The A/E shall serve as the technical representative for CMHA with respect to architectural, engineering, and design matters related to the Work performed under the Contract.
- 3.6.2.** Subject to the Contractor's responsibility under ARTICLE I, the A/E may provide direction on Contract performance.
- 3.6.3.** Such direction shall be within the scope of the Contract and may not be of a nature which:
- A.** Institutes additional work outside of the scope of the Contract;
 - B.** Constitutes a change;
 - C.** Causes an increase or decrease in the cost of the Contract;
 - D.** Alters the Construction Progress Schedule;
 - E.** Changes any of the other express terms or conditions of the Contract;
 - F.** Accepts any defective or non-conforming services, Work, or vendor-furnished items;
 - G.** Makes any settlements on CMHA's behalf;
 - H.** Assumes any responsibilities of the Contractor or Subcontractors; or
 - I.** Binds CMHA to any authorizations under, modifications of, or amendments to the Contract Documents other than as expressly provided A/E'S DUTY, RESPONSIBILITY AND AUTHORITY.
- 3.7.** The Contractor acknowledges and agrees that CMHA's legal counsel may from time to time provide legal services to the Project and that in doing so may communicate with the A/E, as CMHA's representative on the Project.
- 3.7.1.** The Contractor agrees that such communications will be privileged communications and, if there is a Claim contemplated or pending, any written communications will be protected by the attorney client privilege and considered confidential work product.

4. ARTICLE IV PRECONSTRUCTION ACTIVITIES

4.1. Pre-construction Conference

- 4.1.1.** Within ten (10) calendar days, unless otherwise indicated by CMHA, of Contract execution, and prior to the commencement of work, the Contractor shall attend a preconstruction conference with CMHA representatives; CMHA's A/E, and other interested parties convened by CMHA.
- A.** The conference will serve to acquaint the participants with the general plan of the construction operation and all other requirements of the Contract.
 - B.** CMHA will provide the Contractor with the date, time, and place of the conference.

4.2. Certificate of Insurance

- 4.2.1.** Before commencing work, the Contractor and each Subcontractor shall furnish CMHA with certificates of insurance showing the minimum insurance coverage is in force and will insure all operations under the Contract.

4.3. Building and Trade Permits, Licenses and Codes

- 4.3.1.** The Contractor shall give all notices and comply with all applicable laws, ordinances, codes, rules, and regulations.
- A.** Notwithstanding the requirement of the Contractor to comply with the drawings and specifications in the Contract, all Work installed shall comply with all applicable laws, ordinances, codes, rules, and regulations, as may be amended by any waivers.
 - B.** Before installing the Work, the Contractor shall examine all drawings and the specifications for compliance with applicable laws, ordinances, codes, rules, and regulations bearing on the work and shall immediately report, in writing, any discrepancy it may discover to the CMHA's Project Manager and/or Construction Contract Administrator and the A/E.
 - i.** If required by any governing jurisdiction, CMHA will modify the Contract by change order so that the Work on the Project will conform to the applicable laws, ordinances, codes, rules, and regulations.
 - C.** If the Contractor installs any Work that does not comply with all applicable laws, ordinances, codes, rules, and regulations before providing notice hereunder to CMHA and receiving direction from CMHA, Contractor shall be responsible for all costs resulting from any removal, demolishing, and disposing of any Work that must be replaced or repaired.
- 4.3.2.** Notwithstanding the provisions below, the Contractor shall secure and pay for all permits, fees, and licenses necessary for the proper execution and completion of Work.
- A.** Where CMHA can arrange for the issuance of all or part of these permits, fees, and licenses, without cost to the Contractor, the Contract amount shall be reduced accordingly.

4.4. Plan Approval and Permits

- 4.4.1.** The A/E shall facilitate the required structural, plumbing, HVAC, and electrical plan reviews during the design phase, as required by the governing jurisdiction for securing an overall building permit to start construction.
- 4.4.2.** The Contractor shall schedule and attend all intermediate and final inspections required for any permit applicable to the Work or any governing jurisdiction.
- 4.4.3.** The Contractor shall schedule with the State Fire Marshal or local fire authority for the life safety inspection for occupancy permits.
- 4.4.4.** The Contractor shall give the A/E and CMHA reasonable notice of the dates and times for any inspections.
- A.** The Contractor shall pay for all initial inspections and re-inspections required as a result of Contractor's failure to receive approval for its Work.

4.5. Trade Permits and Licenses

- 4.5.1.** The Contractor shall secure and pay the fees for any permit, inspection, or license applicable to the Contractor's particular trade.
- 4.5.2.** Local Permits:
- A.** The Contractor shall secure and pay the fees for any permits, inspections, licenses, capacity charges, or tap fees required by local authorities having jurisdiction over the Project.

- i. The Contractor shall give the A/E and CMHA reasonable notice of the date(s) arranged for inspections.
- 4.5.3. [National Pollutant Discharge Elimination System \(NPDES\) Storm Water General Permit:](#)**
 - A. The A/E shall secure the NPDES general permit by submitting a [Notice of Intent \(NOI\)](#) application form to the Ohio Environmental Protection Agency at least 45 days prior to the start of construction.
 - i. The Contractor shall be a co-permittee, if required under Applicable Law.
 - B. The A/E shall prepare and certify the storm water pollution prevention plan to provide sedimentation and erosion controls at the Project. The A/E shall prepare and process the required [Notice of Termination \(NOT\)](#) prior to Contract Completion.

5. ARTICLE V CONSTRUCTION REQUIREMENTS

5.1. Commencement of Work on Site

- 5.1.1.** Unless CMHA agrees otherwise in writing, the Construction Stage will commence with CMHA issuing the Notice to Proceed and will terminate upon CMHA issuing a Certificate of Contract Completion to the Contractor. The Certificate of Contract Completion will be issued in accordance with the requirements of the Contract Documents and will not occur until after CMHA issues a Certificate of Substantial Completion, a Certificate of Occupancy is issued for the Project, and the Contractor has completed all items on the punch list delivered to Contractor by CMHA as provided in Article IX. The time period for Contract Completion is provided in Section 9.8.
- 5.1.2.** Notice to Proceed:
- A.** The Contractor shall begin work upon the date indicated in a written Notice to Proceed from CMHA or its designee.
 - i.** The Contractor shall not begin work prior to receiving such notice.
 - B.** Typically, the Notice to Proceed shall be issued within 180 days of CMHA Board of Commissioner Approval.
 - C.** If the Notice to Proceed is not issued within 180 days of CMHA Board of Commissioner Approval, CMHA may, in its sole discretion, terminate the Contract without recourse from the Contractor.

5.2. Environmental Controls

- 5.2.1.** The Contractor shall protect its Work and materials from damage from water, moisture, and other weather, including damage from water run-off from other property or structures, and damage from heat, cold, and humidity.
- 5.2.2.** Contractor is not authorized to use permanent HVAC system without express written authorization from CMHA.
- 5.2.3.** Until the permanent HVAC system is complete and available for use:
- A.** The Contractor shall make arrangements and pay for installation and maintenance of temporary heating, cooling and ventilating systems; and
 - B.** The Contractor shall pay the costs incurred in operating the temporary heating, cooling and ventilating systems.
- 5.2.4.** When the permanent HVAC system is complete and available for use:
- A.** The Contractor shall start up and maintain operation of the permanent HVAC system, including filters, and promptly remove temporary heating, cooling and ventilating systems.
 - B.** If the Project consists entirely of new construction, the Contractor shall pay the costs of energy consumed in operating the permanent HVAC system until Substantial Completion.
- 5.2.5.** From the date of Substantial Completion, CMHA shall pay the cost of operating the permanent HVAC system for the occupied portion of the Project.
- 5.2.6.** Use of the permanent HVAC system during construction shall not change, modify or reduce the Contractor's warranty and service obligations under the Contract Documents.

5.3. Construction Procedures

- 5.3.1.** The Contractor is solely responsible for and has control over all construction means, methods, techniques, sequences, and procedures, for safety precautions and programs in connection with the Work, and for coordinating all portions of the Work.
- 5.3.2.** If the Contract Documents give instructions that affect construction means, methods, manners, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety of them and, except as expressly stated herein, be fully and solely responsible for the jobsite safety of the means, manners, methods, techniques, sequences, or procedures.
- 5.3.3.** If the Contractor determines that the means, methods, manners, techniques, sequences, or procedures specified in the Contract Documents may not be safe, the Contractor shall give timely written notice to CMHA.
- A.** The Contractor shall not proceed with that portion of the Work without further written instructions from CMHA.
- 5.3.4.** Additional Contractor Responsibilities:

- A. The Contractor shall lay out and coordinate all lines, levels, elevations, and measurements for all of the Work, coordinate and verify existing conditions, and notify the A/E and CMHA of discrepancies and conflicts before proceeding with installation or excavation.
- B. The Contractor shall perform all cutting, fitting, or patching required for the Work and shall not endanger the Project by cutting, excavating, or otherwise altering the Project or any part of it.
- C. If the Design requires sleeves for completing the specified Work, the Contractor and all Subcontractors shall coordinate to furnish and install the sleeves.
 - i. The Contractors are responsible for the exact location of and size of all holes and openings required to be formed or built for the Work.
- D. The Contractor's patching shall match and blend with the existing adjacent surfaces.
- E. In addition to the items herein, The Contractor is responsible for all items in REF _Ref449941734 \h CONTRACTOR'S RESPONSIBILITIES.

5.4. Utilities**5.4.1. Availability and Use of Utilities**

- A. If CMHA has existing access to utilities, CMHA shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and service as specified herein so long as the utility use does not interfere with CMHA's operations.
 - i. Unless otherwise provided in the Contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to CMHA or where the utility is produced by CMHA, at reasonable rates as determined by CMHA.
 - ii. The Contractor shall carefully conserve any utilities furnished by CMHA without charge.
- B. The Contractor, at its expense and in a manner satisfactory to CMHA, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges.
 - i. Before final acceptance of the Work by CMHA, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

5.4.2. The Contractor shall comply with the requirement of the Ohio Revised Code, including ORC.

- A. In addition, before starting excavation or trenching, the Contractor shall determine the location of any underground utilities and notify any public authority or utility having jurisdiction over the Project and secure any required approval.

5.4.3. The Contractor shall give CMHA at least two (2) business days advance notice of excavation of underground utilities registered with the Ohio Underground Utility Protection Services ("OUPS") and underground utilities shown on the drawings and Specifications who are not registered member of OUPS.

- A. The Owner of an underground utility is required within 48 hours' notice to stake, mark, or otherwise designate the location for its utilities in the construction area together with its approximate depth.
- B. In the event that any underground utility owner fails to timely perform, the Contractor shall notify the A/E and contact CMHA regarding the failure of the underground utility to timely perform its work.

5.4.4. Water and Drainage

- A. The Contractor shall provide water necessary for the Work until the permanent plumbing system is available for use.
- B. The Contractor shall provide all temporary drainage and all dewatering necessary for the Work and shall employ pumps, trenches, drains, sumps, and any other equipment necessary or required to provide satisfactory working conditions for the protection, execution, and completion of the Project. The Contractor shall be responsible for determining the specific means and methods to be used for dewatering.
- C. The Contractor shall make arrangements and pay for installation and maintenance of temporary plumbing systems until the permanent plumbing system is available for use.
- D. When the permanent plumbing system is complete and available for use:
 - i. The Contractor shall start up and maintain operation of the permanent plumbing systems, and make arrangements and pay for removal of temporary plumbing systems.
 - ii. If the Project consists entirely of new construction, the Contractor shall pay the costs of water consumed and sewage charges until Substantial Completion.

- iii. If the Project is a renovation of an existing building or structure, addition(s) to an existing building or structure, or any combination of new construction and renovation work that does not allow separate metering of utilities, CMHA shall pay the costs of water consumed and sewage charges.

- (a) If separate metering of utilities is available, the Contractor and CMHA will pay the costs of their respective use.

- E. After the date of Substantial Completion, CMHA shall pay the costs of water consumed and sewage charges for the occupied portion of the Project.

- F. Use of the permanent plumbing system during construction shall not change, modify, or reduce the Contractor's warranty and service obligations under the Contract Documents.

5.4.5. Electric Service

- A. The Contractor shall provide temporary light and power; pay the charges for temporary electric service, installation, and removal if required.

- B. If the Project consists entirely of new construction, the Contractor shall pay the cost of energy consumed until Substantial Completion.

- C. If the Project is a renovation of an existing building or structure, addition(s) to an existing building or structure, or any combination of new construction and renovation work that does not allow separate metering of utilities, CMHA shall pay the cost of energy consumed.

- i. If separate metering of utilities is available, the Contractor and CMHA will pay the costs of their respective use.

- D. From the date of Substantial Completion, CMHA shall pay the cost of energy consumed for the occupied portions of the Project.

- E. Use of the permanent electrical system during construction shall not change, modify, or reduce the Contractor's warranty and services obligations under the Contract Documents.

5.4.6. Payment of Utility Services

- A. Unless otherwise expressly stated in the Contract Documents, Contractor shall reimburse CMHA the cost of utility services during the Construction Period.

- B. Unless otherwise expressly stated in the Contract Documents, payment for reimbursement of CMHA for the cost of utility services during the Contract Period shall be made directly to CMHA.

- i. If payment is not received, CMHA may deduct the cost of utility services from payments otherwise due to the Contractor.

- ii. If the payments otherwise due to the Contractor are not sufficient to fully reimburse CMHA, either Contractor or its surety shall make whatever payments are necessary to fully reimburse CMHA.

- C. Process for Payment:

- i. Reimbursement from the Contractor shall be performed on a quarterly basis unless a more frequent payment schedule is agreed upon between CMHA and the contractor prior to start of the project.

5.4.7. Hoisting Facilities

- A. The Contractor shall erect and maintain any hoisting equipment required for its Work.

- B. If the electric service requirements of hoisting facilities differ from that available at the Site, the Contractor shall provide and pay for all necessary connections.

- C. If a permanent elevator is identified in the Contract Documents to be used for hoisting materials or personnel during construction, the Contractor shall furnish an extended warranty and service contract in effect until the expiration of the Correction Period.

5.4.8. Interruption of Existing Services

- A. Whenever it becomes necessary to interrupt existing services in use by CMHA or its tenants, including, but not limited to, sewer, water, gas, steam lines, electric, telephone, and cable service, the Contractor shall continue the associated Work on a non-stop 24-hour per day basis until that Work is completed and the service restored, or perform the associated Work at an alternate time as required by and in coordination with CMHA.

- B. Before beginning that Work, the Contractor shall apply in writing to, and receive approval in writing from CMHA to establish a time when interruption of the service will cause a minimum of interference with the activities of CMHA and its tenants.

5.5. Construction Supervision

- 5.5.1.** Unless waived by CMHA in writing, the Contractor shall provide continuous supervision at the Site through a competent project manager or superintendent when any Work is being performed.
- A.** The Contractor's project manager or superintendent shall not be involved with any work for Contractor other than the Project.
- 5.5.2.** The Contractor's project manager and superintendent shall each have responsibility and authority to act on behalf of the Contractor.
- A.** All communication to the Contractor's project manager and superintendent shall be binding as if given directly by the Contractor.
- 5.5.3.** The Contractor shall submit an outline of the qualifications and experience of the Contractor's proposed project manager and superintendent, including references, to CMHA no later than two (2) business days after request from CMHA.
- A.** For all Subcontracts in excess of \$200,000 and for all other Subcontracts requested by CMHA, the Contractor shall submit an outline of the qualifications and experience of the Subcontractor's proposed project manager and proposed superintendent, including references, to CMHA no later than two (2) business days after CMHA's request.
- B.** CMHA may reject the Contractor or Subcontractor's proposed project manager and/or proposed superintendent.
- i.** If CMHA does not notify the Contractor of the rejection within thirty (30) calendar days after receiving the required information, it shall then indicate that CMHA does not have an objection, but does not affect CMHA's rights under the Contract Documents or any other provision relative to the project manager or superintendent.
- C.** If CMHA rejects the Contractor or Subcontractor's proposed project manager or proposed superintendent, the Contractor shall replace, or cause the Subcontractor to replace the project manager or superintendent (as appropriate) with someone acceptable to CMHA at no additional cost.
- 5.5.4.** If CMHA does not object the proposed project manager or superintendent, the Contractor and its Subcontractor shall not replace their respective project managers and superintendents without prior written approval of CMHA.

5.6. Construction Progress Schedule

- 5.6.1.** The Contractor shall, no later than seven (7) calendar days of the issuance of the Notice to Proceed or another period of time determined by the CMHA, prepare and submit to CMHA for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the Work, the dates on which the Contractor contemplates starting and completing the several salient features of the Work (including acquiring labor, materials, and equipment).
- A.** The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period.
- i.** The Chart must be in a Critical Path Method (CPM) format.
- B.** If the Contractor fails to submit a schedule, that is acceptable to CMHA, within the time prescribed, CMHA may withhold approval of progress payments or take other remedies under the Contract until Contractor submits the required schedule that is acceptable to CMHA.
- 5.6.2.** The Contractor shall monitor the Work for conformance with the Construction Progress Schedule and shall initiate revisions as required herein.
- 5.6.3.** The Contractor shall enter the actual progress on the Construction Progress Schedule as required by CMHA, and after each update, Contractor shall immediately deliver three copies of the annotated Construction Progress Schedule to CMHA.
- A.** If CMHA determines, upon the basis of inspection conducted, herein that the Contractor is not meeting the approved Construction Progress Schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by CMHA, without additional cost to CMHA.

- B. If the Contractor is not meeting the approved Construction Progress Schedule, CMHA may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as CMHA deems necessary to demonstrate how the approved rate of progress will be regained.
- 5.6.4. Failure of the Contractor to comply with the requirements of CMHA shall be grounds for a determination by CMHA that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the Contract.
 - A. Upon making this determination, CMHA may terminate the Contractor's right to proceed with the work, or any separable part of it.
- 5.6.5. Unless otherwise agreed to in writing, the Contractor shall develop the Construction Progress Schedule using commercially available, personal computer software acceptable to CMHA and shall submit all baseline and updated schedules to CMHA in the schedule's native format.
 - A. This submission shall be in both electronic and paper format.
- 5.6.6. The Construction Progress Schedule shall not exceed the time limits under the Contract Documents, shall provide for reasonable, efficient, and economical execution of the Project and shall relate to the entire project to the extent required by the Contract Documents.
 - A. In the event that a Construction Progress Schedule submitted by Contractor shows a completion date that extends beyond the Contract Time permitted to Contractor in the Contract Documents, such Construction Progress Schedule shall not be deemed to modify the Contract Time permitted in the Contract Documents. The Contract Time can only be changed by a properly executed Change Order.
- 5.6.7. The Contractor shall use the Construction Progress Schedule to plan, organize, and execute the Project, record and report actual performance and progress, and show how it plans to coordinate and complete all remaining work by Contract Completion within applicable Milestones.
 - A. The Project participants shall use the Construction Progress Schedule as a tool for scheduling and reporting sequences and/or the progress of the Work.
 - B. The Contractor shall provide a clear graphics legend and other data including without limitation Milestone dates, constraints, and other items required by the Project and CMHA.
 - C. Each submission shall show CMHA's Project number and Project name, and provide a signature approval and date line for the Contractor.
- 5.6.8. The Contractor shall provide the following in each Construction Progress Schedule:
 - A. Activity identification and description of each activity broken down to a maximum duration that is appropriate for the activity;
 - B. Contractor or Subcontractor performing each task;
 - C. Contractor's resources and crew size for each activity; and
 - D. Provide early start, early finish, late start, late finish dates.
- 5.6.9. Each Construction Progress Schedule shall show predecessor activities and successor activities for each activity, entry free float, total float and percentage of completion, and identify the appropriate predecessors and successors for all related activities.
- 5.6.10. The Construction Progress Schedule shall show all submittal dates, review and approval durations for coordination drawings, Shop Drawings, other action submittals and mock-up Work.
- 5.6.11. The Contractor shall submit the initial and all updates of the Construction Progress Schedule in graphic and tabular form to CMHA.
 - A. With each monthly Construction Progress Schedule update, the Contractor shall include a list of all changes to the previously approved baseline schedule or monthly updated schedule.
- 5.6.12. The Construction Progress Schedule shall be managed using early start dates and early finish dates.
 - A. The Contractor must exhaust all existing float before claiming additional time for a Change Order.
- 5.6.13. The Contractor's failure to submit and properly maintain an approved Construction Progress Schedule may result in withholding payment in accordance with the Contract Documents.
- 5.6.14. For each Progress Meeting, the Contractor shall provide a 2-6 week look-ahead schedule, as appropriate for the Project.
- 5.6.15. On a monthly basis, the Contractor shall prepare and submit to CMHA a written report describing:
 - A. Activities begun or finished during the preceding month;

- B. Activities in progress and expected completion;
- C. Activities to be started or finished in upcoming month including, without limitation, the Contractor's workforce size and total resource hours associated with those activities;
- D. Recommendations for adjusting the Construction Progress Schedule to meet Milestone dates, the Substantial Completion date and the Contract Completion date; and
- E. Other information requested by CMHA.

5.6.16. If it is apparent that the Contractor may be unable to meet Critical Path activities, Milestone completion dates, the Substantial Completion date(s) or the Contract Completion date, CMHA shall direct the Contractor to submit within three (3) business days a Recovery Plan to avoid or minimize a delay in the Project.

5.6.17. A Recovery Plan shall include, without limitation, adjustments to one or more of the following:

- A. Workforce
- B. Hours per shift
- C. Shifts per workday
- D. Workdays per week
- E. Equipment
- F. Activity logic

5.6.18. If CMHA approves the Recovery Plan, the Contractor shall prepare a revised Construction Progress Schedule within three (3) business days to CMHA.

- A. If CMHA rejects the Recovery Plan, the Contractor shall submit, within three (3) days of CMHA's rejection, an alternate Recovery Plan to CMHA in writing for review and in accordance the Contract Documents.

5.6.19. The Contractor shall update the Construction Progress Schedule on a monthly basis, or other interval as approved by CMHA, in accordance with the Contract Documents.

- A. The Contractor shall submit a tabular copy showing all changes to the previously approved schedule including, without limitation, logic, float, and actual start date of activities.
 - i. The original or initially approved Construction Progress Schedule and all subsequent Construction Progress Schedules submitted by the Contractor, and accepted by CMHA, shall serve as an affirmation that the Contractor agrees to meet the applicable requirements and updated Construction Progress Schedule.
- B. The Contractor's failure to timely submit updated Construction Progress Schedules as deemed necessary by CMHA may result in withholding payments in.

5.7. Progress Meetings

5.7.1. Unless otherwise indicated in writing, CMHA shall schedule weekly Progress Meetings for the Contractor and other persons involved in the Project as deemed necessary for coordination of the Work by CMHA, including Contractor's Subcontractors on the Project.

- A. The purpose of the Progress Meeting is to review progress on the Project during the previous week, discuss anticipated progress during the following weeks, review critical operations, and discuss critical problems.

5.7.2. The Contractor shall be represented at every Progress Meeting by a person authorized with signatory authority to make decisions regarding possible modifications of the Contract Documents or Construction Progress Schedule.

- A. CMHA shall notify the Contractor and other persons involved in the Project of the time and place of the Progress Meeting that shall thereafter be the same day and hour of the week for the duration of the Project, unless CMHA notifies the Contractor and other Persons involved in the Project of a different day and hour at least two (2) business days in advance.
- B. The Contractor shall have any of its Subcontractors attend the Progress Meeting as determined by the Contractor, or as requested by CMHA.
- C. Unless otherwise indicated in writing, CMHA shall prepare a written report of each Progress Meeting and distribute the report to the A/E and the Contractor.

- D. If any person in attendance objects to anything in a report of a Progress Meeting, the person shall notify CMHA and any other affected person in writing explaining the objections within seven (7) calendar days of receipt of the Progress Meeting report.
- E. The report of each Progress Meeting shall reflect any objection made to the report of the previous Progress Meeting and any response.

5.8. Project Coordination

- 5.8.1. If determined needed by CMHA, the Contractor or Subcontractor(s), the Contractor shall prepare Coordination Drawings for any Coordination Area.
 - A. The Contractor shall prepare the Coordination Drawings with Computer-Aided Design ("CAD") or Building Information Modeling ("BIM") software acceptable to CMHA.
 - B. The Coordination Drawings shall show the all affected work, including without limitation, plan and elevation dimensions.
- 5.8.2. After the Contractor completes the Coordination Drawings, the Contractor shall forward a copy of the Coordination Drawings to CMHA.
 - A. The A/E shall report any concerns in writing to the Coordination Participants within fourteen (14) calendar days after receiving the Coordination Drawings.

5.9. Additional Tests and Inspections

- 5.9.1. If the A/E or CMHA determines that any portion of the Work requires special inspection, testing, or approval not otherwise required under the Contract Documents, the A/E and/or CMHA shall order such inspection, testing, or approval.
- 5.9.2. If the special inspection, testing, or approval reveals Defective Work, the Contractor shall pay all associated costs and will not be entitled to any related adjustment of the Contract Times.
 - A. Those costs may include without limitation:
 - i. The cost of special inspection, testing, or approval;
 - ii. The cost of additional special inspections, testing, or approvals, to evaluate Remedial Work;
 - iii. The cost of correcting Defective Work; and
 - iv. All related CMHA-incurred fees and charges of contractors, engineers, architects, attorneys, and other professionals.
- 5.9.3. CMHA may deduct the costs described under the Contract Documents from payments then or thereafter due the Contractor.
 - A. If payments then or thereafter due to the Contractor are not sufficient to cover those amounts, the Contractor or its surety shall immediately pay the amount of the insufficiency to CMHA.
- 5.9.4. If the special inspection, testing, or approval reveals that the Work complies with the Contract Documents, and the Contractor believes that it is entitled to an adjustment of the Contract Sum or Contract Times, or both, on account of the special inspection, testing, or approval, the Contractor may file a Claim by requesting a Change Order by giving written notice within seven (7) calendar days after the special inspection, testing, or approval.
- 5.9.5. If the Contractor is aware of the need of an inspection, testing, or approval, or of a need to have any inspection, testing, or approval completed by a particular time to avoid delay, then the Contractor shall timely communicate such information to CMHA.
- 5.9.6. Except as described in Additional Tests and Inspections, CMHA shall pay for any inspection, testing, or approval that did not become a requirement until after award of the Contract.
- 5.9.7. The Contractor shall coordinate with and give CMHA reasonable notice of the anticipated dates of all inspections, testing, or approvals.

5.10. Review of Contract Documents

- 5.10.1. Before starting each portion of the Work, the Contractor shall carefully study and compare the various Contract Documents relative to that portion of the Work, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the Site affecting it.
- 5.10.2. If the Contractor finds any perceived ambiguity, conflict, error, omission, or discrepancy on or between any of the Contract Documents, or between any of the Contract Documents and any Applicable Law, the Contractor, before proceeding with the Work, shall promptly submit a Request for Information ("RFI") to CMHA for an interpretation or clarification.

- A. Before submitting any RFI, the Contractor shall carefully review the Contract Documents to ensure that the Contract Documents do not answer the RFI.
 - B. If Contractor indicates that the information requested in the RFI affects the critical path of the Project's Construction Progress Schedule and attaches the portion of the Project's Construction Progress Schedule that verifies that the information requested in the RFI affects the critical path, CMHA shall make all reasonable efforts to respond to the RFI within seven (7) business days of receiving the RFI.
- 5.10.3.** If the Contractor believes that it is entitled to an adjustment of the Contract Sum or Contract Times, or both, on account of clarifications or instructions issued in response to a RFI, the Contractor may submit a Claim by requesting a Change Order by giving notice within three (3) business days of receiving the RFI response.
- 5.10.4.** If Contractor does not notify CMHA in accordance with 5.10.3 or any other section that addresses adjustments to the Contract Sum and Contract Time, the Contractor will have accepted the RFI response without an adjustment to the Contract Sum or Contract Time and irrevocably waives his right to submit or request an adjustment to the Contract Sum and/or Contract Time.
- 5.10.5. Frivolous RFI**
 - A. If the Contractor submits a frivolous RFI, as determined by CMHA, Contractor shall be liable to CMHA for the costs related to the review and response of the RFI.
 - i. CMHA may deduct the costs described herein from payments then or thereafter due the Contractor.
 - ii. If payments then or thereafter due to the Contractor are not sufficient to cover CMHA's costs, the Contractor or its surety shall immediately pay the amount of the insufficiency to CMHA.
 - B. Frivolous RFIs may be returned unanswered.
- 5.10.6.** Delays caused by improper or frivolous RFI's are the sole responsibility of the Contractor who shall waive the Contractor's right to seek adjustments to the Contract Sum and Contract Time.
- 5.11. Site Investigation and Conditions Affecting the Work**
 - 5.11.1.** The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including, but not limited to:
 - A. Conditions bearing upon transportation, disposal, handling, and storage of materials;
 - B. The availability of labor, water, electric power and roads;
 - C. Uncertainties of weather, river stages, tides, or similar physical conditions at the site;
 - D. The conformation and conditions of the ground; and
 - E. The character of equipment and facilities needed preliminary to and during work performance.
 - 5.11.2.** The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by CMHA, as well as from the drawings and specifications made part of this contract.
 - A. Any failure of the Contractor Site Investigation and Conditions Affecting the Work will not relieve the Contractor from responsibility for properly estimating or properly evaluating the difficulty and cost of successfully performing the Work without additional expense to CMHA.
 - 5.11.3.** CMHA assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by CMHA.
 - A. Nor does CMHA assume responsibility for any understanding reached or representations made concerning conditions which can affect the Work by any of its officers or agents before execution of this Contract, unless that understanding or representation is expressly stated in this Contract.
- 5.12. Protection of the Project**
 - 5.12.1.** The Contractor shall protect the Project from weather and maintain the Work and all materials, apparatus, and fixtures free from injury or damage until Substantial Completion of the Work.
 - A. The Contractor shall at all times cover or protect the Work and materials.
 - B. The Contractor, at its own expense, shall remove, and replace with new, any Work damaged as a result of the Contractor's failure to provide coverage or protection.

- C. After the date of Substantial Completion of the Work, CMHA is responsible for protecting and maintaining all materials, apparatus, and fixtures for the occupied portion of the Project from injury or damage.
- 5.12.2.** The Contractor shall protect the Project and existing or adjacent property from damage at all times and shall erect and maintain necessary barriers, lateral support, furnish and keep lighted necessary danger signals at night, and take reasonable precautions to prevent injury or damage to individuals or property.
- 5.12.3. Temporary Heating**
 - A. The Contractor shall provide and pay for temporary heating, covering, and enclosures necessary to protect all Work and materials against damage by dampness and cold, to dry out the Work, and to facilitate the completion of Work.
 - B. Any permanent heating equipment used by Contractor or Subcontractors shall be turned over to CMHA in the condition and at the time required by the specifications.
- 5.12.4.** The Contractor shall not load, or permit any part of the Project to be loaded, in any manner that endangers the Project, or any proportion thereof.
 - A. The Contractor shall not subject any part of the Project or existing or adjacent property to stress or pressure that endangers the Project or property.
- 5.12.5. Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements**
 - A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work sites, which are not to be removed under this Contract, and which do not unreasonably interfere with the Work required under this Contract.
 - B. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place.
 - i. If any limbs or branches of trees are broken during performance of this Contract, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as specifically directed by CMHA.
 - C. The Contractor shall protect from damage all existing improvements and utilities (1) at or near the work site and (2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor.
 - i. Prior to disturbing the ground at the construction site, the Contractor shall ensure that all underground utility lines are clearly marked.
 - D. The Contractor shall shore up, brace, underpin, secure, and protect as necessary all foundations and other parts of existing structures adjacent to, adjoining, and in the vicinity of the site, which may be affected by the excavations or other operations connected with the construction of the Project.
 - E. Any equipment temporarily removed as a result of work under this Contract shall be protected, cleaned, and replaced in the same condition as at the time of award of this Contract.
 - F. New work which connects to existing Work shall correspond in all respects with that to which it connects and/or be similar to existing Work unless otherwise required by the specifications.
 - G. No structural members shall be altered or in any way weakened without the written authorization of CMHA, unless such work is clearly specified in the Plans or specifications.
 - H. If the removal of the existing Work exposes discolored or unfinished surfaces, or work out of alignment, such surfaces shall be refinished, or the material replaced as necessary to make the continuous work uniform and harmonious.
 - i. This, however, shall not be construed to require the refinishing or reconstruction of dissimilar finishes previously exposed, or finished surfaces in good condition, but in different plans or on different levels when brought together by the removal of intervening work, unless such refinishing or reconstruction is specified in the plans or specifications.
 - I. The Contractor shall give all required notices to any adjoining or adjacent property owner or other party before commencement of any Work.

- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA, from and against all claims, (whether alleged or proven), demands, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs arising out of or related to the settlement or the loss of lateral support of adjoining property, any damages from changes in topography affecting drainage, and from all loss or expense and all damages for which CMHA may become liable in consequence of such injury or damage to adjoining and adjacent structures and their premises.
- K. The Contractor shall repair any damage to vegetation, structures, equipment, utilities, or improvements, including those that are the property of a third party, resulting from failure to comply with the requirements of this Contract or failure to exercise reasonable care in performing the work.
 - i. If the Contractor fails or refuses to repair the damage promptly, CMHA may have the necessary Work performed and charge the cost to the Contractor.

5.12.6. Vibration, Noise, and Dust Control

- A. The Contractor shall provide controls/barriers for vibrations, noise, and dust control in occupied buildings as required by the construction operations.
- B. The Contractor will not be permitted to exhaust or release unfiltered air, dust, construction debris, or other undesirable products into the exterior atmosphere or into occupied areas of the building.
 - i. CMHA may limit or stop the Work if the Contractor does not maintain proper air-quality standards.
 - ii. Such stoppage may result in a charge to the Contractor.
- C. In certain occupied buildings, tasks might be of such a nature that noise and vibration cannot be tolerated.
 - i. In such spaces and as approved by CMHA, Work may be scheduled for other than normal working hours.
 - ii. The Contractor is cautioned that weekend or overtime work, if required, shall be performed at no additional cost.
 - iii. Permission to work other than standard hours shall be received from CMHA prior to the occurrence.
 - iv. Weekend or overtime Work shall be reflected in the Construction Progress Schedule.
- D. The Contractor is responsible for vibration control and control of transmission of noise arising from the Work.
- E. Principal considerations that shall be given to noise and vibrations control are:
 - i. Noise control in compliance with Occupational Safety and Health Administration (OSHA) shall be for all areas of the facility, including equipment rooms, boiler rooms, and fan rooms.
 - ii. Vibration control to limit sound produced by construction equipment, and for protection of the equipment existing in the building and the building structure.
 - iii. Vibration control to provide for the maximum usefulness of the facility by keeping levels of vibration within ranges conducive to peaceful enjoyment of residential living or work or other uses for which the facility was designed

5.13. General Warranty - Materials, Equipment and Workmanship

- 5.13.1.** The Contractor warrants to CMHA and A/E that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise.
 - A. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit.
 - B. Work, materials, or equipment not conforming to these requirements may be considered defective.
 - C. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage.
 - D. If required by the A/E, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

5.13.2. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA from and against all claims, (whether alleged or proven), demands, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, arising out of or relating to the Contractor's breach of any warranty obligations.

A. The Contractor's obligation shall be joint and several.

5.13.3. Additional Warranties

A. The Contractor gives the Owner the following additional warranties:

- i.** If the Contractor's Work includes all or part of the exterior roofing system, provided that the A/E has designed the roofing system to be weather tight, the Contractor warrants that the roofing system will be weather tight; and
- ii.** If the Contractor's Work includes all or part of the exterior wall system, provided that the A/E has designed the wall system to be weather tight, the Contractor warrants that the wall system will be weather tight.

(a) Weather tight shall mean the roofing and/or wall system does not permit any infiltration of water in any form that would have any adverse effect on the Owner's operations or the Project.

5.13.4. The Contractor shall, prior to Contract Completion and as a condition precedent to final payment to Contractor, assign to CMHA all manufacturer's warranties related to the materials and labor used in the Work and further agrees to perform the Work in such manner as to preserve any and all such manufacturer's warranties and deliver to the A/E the warranties, project manual, operating procedures, and other materials related to each of the building systems and materials included in the Contractor's Work and as required by the Specifications.

5.13.5. Upon notice of the breach of any of the warranties or guarantees identified herein, or any other warranties or guarantees under the Contract Documents, the Contractor, in addition to any other requirements in the Contract Documents, shall commence to correct such breach and all damage resulting therefrom within two (2) business days from written notice thereof, thereafter use its best efforts to correct such breach and damage to the satisfaction of CMHA and A/E, and, except when an extension of time is granted in writing by CMHA, correct such breach and damage to the satisfaction of CMHA within thirty (30) calendar days of such notice, or such other time as provided in the notice; provided, however, that if such notice is given after final payment the 2-day period shall be extended to seven (7) calendar days.

- A.** If the Contractor fails to commence to correct such breach and damage, or to correct such breach or damage as provided above, the Owner, without prejudice to any of its other rights or remedies at law or under the Contract Documents, may correct the breach without further notice to Contractor.
- B.** The Contractor shall pay the Owner's reasonable costs and expenses incurred in connection with the or related to such correction and/or breach, including without limitation the Owner's administrative, legal, and consulting expenses and additional service fees of the A/E.
- C.** The foregoing warranties and obligations of the Contractor shall survive final payment and/or termination of the Contract and shall not be limited by any other terms contained in the Contract Documents.
- D.** If the Contractor fails to pay the Owner any amounts due hereunder, the Contractor shall pay the Owner, in addition to the amounts due, a late payment fee of one and one-half percent (1.5%) per month for each month or part thereof that the payments are not paid when due.

5.13.6. Contractor shall bring to or store at the Site only the materials and equipment required for the Work.

A. If possible, materials and equipment should be installed in their final positions when brought to the Site.

5.13.7. All equipment, material, and articles furnished under this Contract shall be of the most suitable grade for the purpose intended, unless otherwise specifically provided in this Contract.

A. References in the Contract to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition.

- B. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of, and as approved by CMHA in writing, is equal to that named in the specifications, unless otherwise specifically provided in this Contract so long as Contractor has submitted a substitution request to CMHA.
- C. If the substituted material has not been approved by CMHA in writing, the substituted material may be considered Defective Work by CMHA or A/E.

5.13.8. Approval of Equipment and materials

- A. The Contractor shall obtain CMHA's approval of the machinery and mechanical and other equipment to be incorporated into the work.
 - i. When requesting approval, the Contractor shall furnish to CMHA the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the machinery and mechanical and other equipment
 - ii. When required by this contract or by CMHA, the Contractor shall also obtain CMHA's approval of the material or articles which the Contractor contemplates incorporating into the work.
 - iii. When requesting approval, the Contractor shall provide full information concerning the material or articles.
 - iv. Machinery, equipment, material, and articles that do not have the required approval shall be installed or used at the risk of subsequent rejection.
- B. When required by the specifications or CMHA, the Contractor shall submit appropriately marked samples (and certificates related to them) for approval at the Contractor's expense, with all shipping charges prepaid.
 - i. The Contractor shall label, or otherwise properly mark on the container, the material or product represented, its place of origin, the name of the producer, the Contractor's name, and the identification of the construction project for which the material or product is intended to be used.
- C. Certificates shall be submitted electronically in triplicate, describing each sample submitted for approval and certifying that the material, equipment or accessory complies with contract requirements.
 - i. The certificates shall include the name and brand of the product, name of manufacturer, and the location where produced.
- D. Approval of a sample shall not constitute a waiver of CMHA's right to demand full compliance with contract requirements.
 - i. Materials, equipment and accessories may be rejected for cause even though samples have been approved.
- E. Wherever materials are required to comply with recognized standards or specifications, such specifications shall be accepted as establishing the technical qualities and testing methods, but shall not govern the number of tests required to be made nor modify other Contract requirements.
 - i. CMHA may require laboratory test reports on items submitted for approval or may approve materials on the basis of data submitted in certificates with samples.
 - ii. Check tests will be made on materials delivered for use only as frequently as CMHA determines necessary to insure compliance of materials with the specifications.
 - iii. The Contractor will assume all costs of retesting materials which fail to meet contract requirements and/or testing materials offered in substitution for those found deficient.
- F. After approval, samples will be kept in the Project office until completion of work.
 - i. They may be built into the work after a substantial quantity of the materials they represent has been built in and accepted.
- G. **Requirements concerning lead-based paint**
 - i. The Contractor shall comply with the requirements concerning lead-based paint contained in the Lead-Based Paint Poisoning Prevention Act.

5.13.9. Substitutions

- A. If the Contractor provides approved Substitutions that require changes to the Contract Documents, the Contractor shall be solely responsible for the additional costs incurred as a result, including without limitation changes to the design by the A/E.

- B. CMHA shall consider Requests for Substitutions after the bid opening only when the Contractor can conclusively demonstrate CMHA the following conditions:
 - i. The specified Basis of Design Components, Acceptable Components, or previously approved Substitutions through no fault of the Contractor are not available; or
 - ii. The specified Basis of Design Components, Acceptable Components, or previously approved Substitutions will not perform as designed or intended.
- C. The Contractor's incorporation of unapproved Substitutions in the Work shall constitute Defective Work.
- D. If the Contractor provides an unacceptable Component, the Contractor shall be solely responsible for the costs of coordination and modification required.

5.14. Specifications and Drawings for Construction

- 5.14.1.** The Contractor shall keep on the work site a stamped, permit set of the drawings and specifications and shall at all times give CMHA access thereto.
- A. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both.
 - B. In case of difference between drawings and specifications, the specifications shall govern.
 - C. In case of a discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to CMHA, who shall promptly make a determination in writing.
 - D. Any adjustment by the Contractor without such determination shall be at its own risk and expenses.
 - E. CMHA shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.
- 5.14.2.** Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of CMHA is intended.
- 5.14.3.** Where "shown," indicated", "detailed", or words of similar import are used, it shall be understood that the reference is made to the drawings accompanying this Contract unless otherwise stated, the word "provided" as used herein shall be understood to mean "provide complete in one place" that is "furnished and installed".
- 5.14.4.** "Shop Drawings" means drawings, submitted to CMHA by the Contractor, subcontractor or any lower tier subcontractor, showing in detail, 1) the proposed fabrication and assembly of structural elements and 2) the installations (i.e., form, fit, and attachment details) of materials of equipment.
- A. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the work required by the Contract.
 - B. CMHA may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.
- 5.14.5.** If this Contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with other Contract requirements and shall indicate its approval thereon as evidence of such coordination and review.
- A. Shop Drawings submitted to the A/E without evidence of the Contractor's approval may be returned for resubmission.
 - B. CMHA will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate CMHA's reasons therefore.
 - C. Any Work done before such approval shall be at the Contractor's risk.
 - D. Approval by the A/E shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this Contract, except with respect to approved variations.
- 5.14.6.** If shop drawings show variations from the Contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission.
- A. If the A/E approves any such variation and CMHA concurs, CMHA shall issue an appropriate modification to the Contract, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.

5.14.7. It shall be the responsibility of the Contractor to make timely requests to CMHA for such large scale and full size drawings, color schemes, and other additional information, not already in possession, which shall be required in the planning and production of the work.

A. Such requests may be submitted as the need arises, but each such request shall be filed with ample time to permit appropriate action to be taken by all parties involved so as to avoid delay.

5.14.8. The Contractor shall electronically submit to CMHA for approval (unless otherwise indicated) all shop drawings as called for under the various headings of the specifications.

A. As required by CMHA, the Contractor, upon completing the work under this Contract, shall furnish a complete set of drawings as finally approved.

B. These drawings show all changes and revisions made up to the time the work is completed and accepted.

5.14.9. Specifications and Drawings for Construction shall be included in all Subcontracts at any tier.

A. It shall be the responsibility of the Contractor to ensure that all shop drawings prepared by Subcontractors are submitted to CMHA.

5.15. As Built Drawings

5.15.1. "As-built drawings," means drawings submitted by the Contractor or subcontractor at any tier to show the construction of a particular structure or Work as actually completed under the Contract.

A. "As-built drawings" shall be synonymous with "Record Drawings".

5.15.2. As required by CMHA, the Contractor shall provide CMHA accurate information to be used in the preparation of permanent as-built drawings.

A. For this purpose, the Contractor shall record on one set of Contract drawings all changes from the installations originally indicated, and record final locations of underground lines by depth from finish grade and by accurate horizontal offset distances to permanent surface improvements such as buildings, curbs, or edges of walks.

5.15.3. As Built Drawings shall be included in all subcontracts at any tier.

5.15.4. It shall be the responsibility of the Contractor to ensure that all As-Built Drawings prepared by Subcontractors are submitted to CMHA.

5.16. Project Document Maintenance and Submittal

A. During Construction

i. The Contractor shall maintain in good order at a secure location on the Site:

(a) A complete copy of all Contract Documents; Shop Drawings, Product Data, samples and similar required submittals; manufacturer operating and maintenance instructions; certificates; warranties; RFIs and responses thereto; and other Project-related documents, all marked currently and accurately to record field changes and selections made during construction and to show actual installation where installation varies from Work as originally shown, including the exact location and depth of underground utility lines; and

(b) A set of Drawings as approved by any applicable jurisdiction and Specifications.

B. Before submitting each Contract Payment Request, the Contractor shall record all changes on the Contract Documents, neatly in a contrasting color, noting new information not shown on the original Contract Documents.

i. Failure to record all changes may cause payment to be withheld or delayed by CMHA.

C. The Contractor shall keep a record of changes made to the Specifications, noting particularly any approved variation from manufacturer's installation instructions and recommendations.

D. If the Contractor uses Shop Drawings to indicate as-built conditions, the Contractor shall cross-reference the Shop Drawing sheet numbers to the corresponding sheet numbers on the Contract Documents.

i. The Contractor shall note related numbers where applicable.

5.16.2. Before Contract Completion

A. The Contractor, as a condition precedent to execution of the Certificate of Contract Completion and final payment, shall organize the As-Built Documents into manageable sets, bind the sets with durable paper cover sheets, and deliver the As-Built Documents to CMHA.

B. The Contractor's As-Built Documents submission shall include, but is not limited to:

- i. Certificate of Occupancy;
 - ii. Inspection certificates for pressure piping, elevator, boiler, electrical, plumbing or piping purification, etc.
 - iii. Letter of Approval from the local fire authority or State Fire Marshal for the fire suppression system;
 - iv. Operation and Maintenance Manuals, organized into suitable sets of manageable size;
 - v. Indexed data bound in individual binders, with pocket folders for folded sheet information and appropriate identification marked on the front and the spine of each binder;
 - vi. Neatly and accurately marked sets of As-Built Documents, and other Contract Documents reflecting the actual construction of the Project;
 - vii. Detailed Drawings reflecting the exact location of any concealed utilities, mechanical or electrical systems, and components;
 - viii. Assignment to CMHA of all warranties and guarantees, including the most-recent address and telephone number of any Subcontractors or manufacturers;
 - ix. An affidavit to certify that all Subcontractors have been paid in full for all Work performed or materials furnished for the Project;
 - x. A final lien waiver for both the Contractor and all Subcontractors of any tier;
 - xi. Final certified payroll reports; and
 - xii. An affidavit to certify that the Contractor and each of its Subcontractors, regardless of tier, have complied with all requirements of ORC.
- C. By submitting the As-Built Documents to CMHA, the Contractor certifies that its As-Built Documents are complete, correct, and accurate.

5.17. Temporary Buildings and Transportation of Materials

- 5.17.1.** Temporary buildings (e.g., storage sheds, shops, offices, sanitary facilities) and utilities may be erected by the Contractor only with the approval of CMHA and shall be built with labor and materials furnished by the Contractor without expense to CMHA.
- A. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work.
 - B. With the written consent of CMHA, the buildings and utilities may be abandoned and need not be removed.
- 5.17.2.** The Contractor shall, as directed by CMHA, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by CMHA.
- A. When materials are transported in prosecuting the Work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any federal, state, or local law or regulation.
 - B. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage.
 - C. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

5.18. Facilities

- 5.18.1.** The Contractor shall provide and maintain in a clean condition:
- A. Suitable facilities, including temporary facilities, equipment, services, and enclosed storage for its use at the Site;
 - B. Adequate space, equipment, and furnishings to conduct progress meetings, and store approved documents and permits; and
 - C. Adequate sanitary facilities for use by all Persons at the Site.

5.19. Progress Cleaning

- 5.19.1.** The Contractor shall remove all waste materials, rubbish, and mud attributable to the Work in accordance with the Specifications, if applicable, and to an appropriate disposal location at, or near, the Site.
- 5.19.2.** The Contractor shall perform weekly broom cleaning of hard flooring surfaces in the area of the Work.
- 5.19.3.** The Contractor shall remove, at the end of each working day or more frequently, as appropriate, for the Project, all waste materials and rubbish from the disposal location at, or near, the Site.

- 5.19.4.** The Contractor shall remove, as appropriate for the Project or as the A/E or CMHA directs, any waste materials or rubbish from areas adjacent to the Project.
- 5.19.5.** The Contractor shall dispose of waste materials, rubbish, and construction debris in a lawful manner in approved recycling facilities or landfills and record of such disposal shall be available upon written request of CMHA.
- 5.19.6.** If the Contractor fails to clean up during the progress of the Work, CMHA may clean up on behalf of the Contractor and at the Contractor's expense.
- A.** If the Contractor fails to maintain the areas adjacent to the Project clean and free of waste materials and rubbish, CMHA may also direct the local jurisdiction responsible for the area to have the area cleaned to its satisfaction at the Contractor's expense.
- B.** CMHA may deduct the cleaning costs from payments then or thereafter due the Contractor.
- i.** If payments then or thereafter due the Contractor are not sufficient to cover those amounts, the Contractor shall immediately pay the amount of the insufficiency to CMHA.
- 5.19.7.** The Contractor shall remove excavated material and spoil to a suitable off-site location approved by CMHA.
- A.** If CMHA designates a location on its property for disposal or storage of clean topsoil and/or subsoil in the Contract Documents, the Contractor shall remove such materials to the designated location.
- 5.20. Use of Premises**
- 5.20.1.** The Contractor shall use corridors, stairs, and elevators as designated by CMHA and only during those times that are designated by CMHA.
- A.** The Contractor shall exercise extreme care to not exceed the carrying capacity of elevators or damage the cab interior in any way.
- 5.20.2.** Loitering or wandering through interior of buildings or exterior grounds outside the limits of the Work will not be permitted.
- 5.20.3.** The Contractor shall confine its apparatus, materials, and the operations of its workers to the limits indicated by law, ordinances, permits and the directions of CMHA.
- 5.20.4.** Unless expressly required or approved by CMHA, no signs or advertising of any kind will be permitted on or about the Site, except those appearing on trucks and trailers.
- 5.20.5. CMHA Use of Premises / Possession Prior to Completion**
- A.** CMHA shall have the right to take possession of or use any completed or partially completed part of the Work.
- i.** Before taking possession of or using any work, CMHA shall furnish the Contractor a list of items of Work remaining to be performed or corrected on those portions of the Work that CMHA intends to take possession of or use.
- ii.** However, failure of CMHA to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the Contract.
- iii.** CMHA's possession or use shall not be deemed acceptance of Work under the Contract.
- B.** While CMHA has such possession or use, the Contractor shall be relieved of the responsibility for:
- i.** The loss of or damage to the Work resulting from CMHA's possession or use, notwithstanding the terms herein;
- ii.** All maintenance costs on the areas occupied; and
- iii.** Furnishing heat, light, power, and water used in the areas occupied without proper remuneration therefore.
- C.** If requested by the Contractor and if prior possession or use by CMHA delays the progress of the Work or causes additional expense to the Contractor, an equitable adjustment shall be made in the Contract Sum, the Contract Time, or both, and the Contract shall be modified in writing accordingly.
- 5.21. Smoking and Tobacco Products**
- 5.21.1.** Smoking is not permitted at any property under construction, unless CMHA has a specifically designated area for smoking, and is not permitted within 50 feet of any entrance of a CMHA owned building.
- A.** This prohibition applies to new construction and rehabilitation.

- B. The Contractor shall enforce these restrictions on any individual employed by the Contractor, or a Subcontractor.

5.22. Correction of the Work

5.22.1. Before Substantial Completion

- A. If the Contractor provides Defective Work or fails or neglects to perform the Work in accordance with the Construction Progress Schedule, CMHA or the A/E may issue a written notice to the Contractor and Contractor's Surety directing the Contractor to correct the Defective Work or recover schedule deficiencies.
 - i. Unless otherwise specified in that written notice, the Contractor shall begin to correct the Defective Work and recover the schedule deficiencies within no more than three (3) business days after CMHA issues the written notice.
- B. If the Contractor fails to commence and diligently pursue correction of Defective Work or recovery of schedule deficiencies within three (3) business days of Contractor's receipt of written notice from CMHA or the A/E, CMHA may correct the Defective Work or take action to recover schedule deficiencies without giving further notice to the Contractor or Contractor's Surety.

5.22.2. During the Correction Period

- A. If CMHA issues a notice during the Correction Period, CMHA may correct the Defective Work itself without giving further notice to the Contractor or Contractor's Surety if the Contractor fails to:
 - i. Notify CMHA in writing of the Contractor's intent to correct the Defective Work within three (3) business days after CMHA issues the notice; and
 - ii. Thereafter promptly commence and diligently pursue correction of Defective Work.
- B. *The Correction Period:*
 - i. Commences in accordance with 23.1.41;
 - ii. Relates only to the Contractor's specific obligation and opportunity to correct the Work during the Correction Period;
 - iii. Does not establish a period of limitation with respect to any of the Contractor's other obligations under the Contract Documents;
 - iv. Has no relationship to the time within which CMHA may seek to enforce the Contract; and
 - v. Does not establish a period of limitation with respect to the commencement of litigation to establish the Contractor's liability under the Contract or otherwise.
- C. *After the Correction Period:*
 - i. CMHA may correct, at the Contractor's expense, the Defective Work without giving further notice to the Contractor or Contractor's Surety if the Contractor or Contractor's surety fails to
 - (a) Notify CMHA in writing of the intent to correct the Defective Work; and
 - (b) Promptly commence and diligently pursue correction of Defective Work.

5.22.3. After Substantial Completion

- A. In addition to the Contractor's other obligations under the Contract Documents, if any of the Work is found to be Defective Work after Substantial Completion, the Contractor shall correct it promptly after receipt of written notice from CMHA to do so, unless CMHA has previously acknowledged and accepted the Defective Work in writing.
- B. CMHA may send a copy of the written notice to the Contractor's Surety, but are not obligated to do so.

5.22.4. Emergency Correction of Defective Work

- A. Notwithstanding any other provision of the Contract, if in CMHA's opinion the Defective Work presents a threat of imminent harm or danger to people, property, or the environment, CMHA may order the Contractor to immediately correct Defective Work or CMHA may correct the Defective Work, at Contractor's expense, itself without any prior notice to the Contractor or Contractor's Surety.

5.22.5. Responsibility for Costs of Correction

- A.** To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA, from and against all claims, (whether alleged or proven), demands, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, associated with the correction of Defective Work and the recovery of schedule deficiencies.
- B.** Those costs and damages may include, but are not limited to:
 - i.** The related fees and charges of contractors, engineers, architects, attorneys, and other professionals; and
 - ii.** The cost of correcting or replacing adjacent work.
- C.** CMHA may deduct those costs and damages from payments then or thereafter due the Contractor.
 - i.** If payments then or thereafter due the Contractor are not sufficient to cover those amounts, the Contractor shall immediately pay the amount of the insufficiency to CMHA.

6. ARTICLE VI SUBCONTRACTORS

6.1. Evaluation and Approval

- 6.1.1.** When submitting its Bid, the Contractor shall submit a Subcontractor and Material Supplier Declaration form through which the Contractor identifies its Subcontractor.
- A.** Provide list of subcontractors and material supplier and equipment with bid.
- 6.1.2.** Within ten (10) calendar days after the Notice to Proceed, the Contractor shall submit to CMHA, an **updated** Subcontractor and Material Supplier Declaration form.
- 6.1.3.** If CMHA rejects any proposed Subcontractor, the Contractor shall propose a replacement Subcontractor with no adjustment of the Contract Sum.
- A.** The proposed replacement will also be evaluated by CMHA.
- 6.1.4.** The Contractor's failure to timely submit the information regarding a proposed Subcontractor may result in withholding payment to Contractor.

6.2. Suspension/Debarment

- 6.2.1.** The Contractor shall not enter into any Subcontract with any Subcontractor who has been temporarily denied participation in a HUD program or who has been suspended or debarred from participating in contracting program by any agency of the United States Government or the State of Ohio.

6.3. Contractor's Responsibility

- 6.3.1.** The Contractor shall be as fully responsible for the acts or omissions of its Subcontractors and of persons either directly or indirectly employed by them as for the acts or omissions of persons directly employed by the Contractor, and is responsible for scheduling and coordinating the Work of the Subcontractors.
- 6.3.2.** The Contractor is fully responsible for any delay, interference, disruption, or hindrance attributable to the Contractor's Subcontractors.
- 6.3.3.** The Contractors shall require that each of its Subcontractors have a competent supervisor at the Site whenever the Subcontractor is performing Work.
- 6.3.4.** The Contractor shall bind its Subcontractors to the terms and conditions of the Contract Documents, so far as applicable to the Work of the Subcontractor, and shall not agree to any provision, which seeks to bind CMHA with terms inconsistent with or at variance from the Contract Documents.
- 6.3.5.** The Contractor will not be relieved of its full responsibility for Subcontractors and their performance of the Work by:
- A.** The participation of CMHA, HUD, or the A/E in the processes described under ARTICLE VI SUBCONTRACTORS or other related provisions of the Contract Documents; or
- B.** CMHA's rejection of a Subcontractor or failure to reject a Subcontractor.

6.4. Mandatory Contract Provisions/Forms

- 6.4.1.** The Contractor shall insert appropriate clauses in all Subcontracts to bind Subcontractors to the terms and conditions of this Contract insofar as they are applicable in the work of Subcontractors.
- 6.4.2.** CMHA reserves the right to reassign accepted agreements
- 6.4.3.** Nothing contained in this Contract shall create any contractual relationship between any Subcontractor and CMHA or between the Subcontractor and HUD.
- 6.4.4.** The Contractor must include in the contract with its Subcontractors the applicable labor provisions and prevailing wages as was provided to the Contractor by CMHA.
- 6.4.5.** No less than ten (10) calendar days before the Work is to be performed by a Subcontractor, or within a shorter period as mutually agreed by the Contractor and CMHA, the Contractor shall submit to CMHA a complete copy of the executed Subcontract between the Contractor and Subcontractor.

6.5. Replacement of Subcontractors

- 6.5.1.** The Contractor shall not replace any Subcontractor after execution of the Subcontract without prior written approval of CMHA.
- 6.5.2.** The Contractor shall not add any subcontractors after the Contract Execution without updating the Material supplier and subcontractor form or prior to written approval of CMHA.

6.6. Contingent Assignment of Subcontract

6.6.1. The Contractor hereby assigns its Agreement with each Subcontractor to CMHA provided that the assignment is effective only after termination of the Contract by CMHA and only for those agreements that CMHA accepts by notifying Contractor and applicable Subcontractor in writing.

6.7. Prompt Payment of Subcontracts

6.7.1. The Contractor shall make payments to the Subcontractor in accordance with Applicable Law, including ORC that include, without limitation, the requirements under 6.7 - Prompt Payment of Subcontracts.

6.7.2. If a Subcontractor requests payment in time to allow the Contractor to include the request in its Contractor Payment Application Request the Contractor, within ten (10) calendar days after receipt of payment from CMHA, shall pay to the:

- A.** Subcontractor, an amount equal to the percentage of completion of the Subcontractors contract allowed by CMHA for the amount of labor or work performed;
- B.** Material Supplier, an amount that is equal to all or a portion of the invoice for materials which represents the materials furnished by the material supplier

6.7.3. The Contractor may reduce the amount paid by any retainage provision contained in the Contract, invoice, or purchase order between the Contractor and Subcontractor and may withhold amounts that may be necessary to:

- A.** Resolve disputed liens or claims involving the Work or labor performed by the Subcontractor; or
- B.** Account for failure of the Subcontractor to perform its obligations under its agreement with the Contractor required under ORC

6.7.4. Labor Payments

A. Within ten (10) calendar days of receipt of payment from CMHA, the Contractor shall pay Subcontractor in the following manner:

- i.** Partial payments to the Subcontractor for labor performed under either a Unit Price or lump sum Subcontract shall be made at the rate of 92 percent of the amount invoiced through the Subcontractor's request for payment that shows the Work of the Subcontractor is 50% complete.
- ii.** After the Work of the Subcontractor is 50 percent complete, as evidenced by payments of at least 50 percent of the total amount due under the Subcontract, no additional funds shall be retained from payments for labor.

6.7.5. Material Payment

A. Required by ORC for payment to Contractor by CMHA

- i.** The Contractor shall pay the Subcontractor at the rate of 95% of the invoice cost, not to exceed the scheduled value in a unit price or lump sum Subcontract, for materials delivered to the Site, or other offsite storage location approved by CMHA, provided the Subcontractor provides the information required with its request for payment.
- ii.** The Contractor shall pay the Subcontractor at the rate of 100% of the scheduled value for materials incorporated into the Project.

6.7.6. If Contractor fails to comply with the payment provisions set forth, the Contractor shall pay to the applicable Subcontractor, in addition to any payment due, interest in the amount of 18 percent per annum of the payment due, beginning the eleventh day following the receipt of payment from CMHA and ending on the date of full payment of the payment due plus interest.

6.7.7. If CMHA receives a Claim Affidavit from a Subcontractor, Subcontractor shall proceed in accordance with Applicable Law, including Ohio Revised Code.

6.7.8. Laborers, Subcontractors, and Material Suppliers may secure payment rights in accordance with Applicable Law, including Ohio Revised Code.

6.8. Subcontracting with Small and Minority Firms, Women's Business Enterprise, and Labor Surplus Area Firms

6.8.1. The Contractor shall take the following steps to ensure that, whenever possible, Subcontracts are awarded to small business firms, minority firms, women's business enterprises, and labor surplus area firms:

- A.** Placing qualified small and minority businesses and women's business enterprises on solicitations lists;

- B.** Ensuring that small and minority businesses and women's business enterprises are solicited whenever they are potential resources
- C.** Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses and women's business enterprises;
- 6.8.2.** Establishing delivery schedule, where the requirements of the Contract permit, which encourages participation by small and minority businesses and women's business enterprises; and
- 6.8.3.** Using the services and assistance of the U.S. Small Business Administration, the Minority Business Development Agency of the U.S. Department of Commerce, and State and local governmental small business agencies

7. ARTICLE VII PAYMENTS

7.1. CMHA Obligation

- 7.1.1. CMHA shall pay the Contractor the price as provided in the Contract.

7.2. Forms

- 7.2.1. Unless expressly authorized to the contrary, Contractor must use appropriate CMHA forms.

7.3. Step One – Pencil Application

- 7.3.1. The purpose of a pencil application is assisting the Contractor in identifying any potential error or omission in the pay application.
- A. If submitted timely (as set forth below) CMHA will review and help identify any potential issues. However, the CMHA Construction Administrator's approval or suggestion does not guarantee approval of the payment application by the CMHA.
- 7.3.2. The Contractor shall initially submit a Pencil Application by no later than the 15th of each month.
- A. The CMHA Construction Administrator will review the Pencil Application, and make any suggested corrections and return to the Contractor in approximately two (2) business days.
- 7.3.3. The Contractor shall then submit the final payment application to the CMHA Construction Administrator by the 23rd of each month.
- 7.3.4. Failure to submit a pencil application may result in a significant delay in payment.

7.4. Progress Payments

- 7.4.1. CMHA shall make progress payments approximately every forty-five (45) calendar days as the work proceeds on estimates of Work accomplished which meets the standards of quality established under the Contract, as approved by CMHA.
- A. Subject to CMHA's written determination and approval more frequent payments may be made to contractors which are qualified as small businesses.
- 7.4.2. Before the first progress payment under this contract, the Contractor shall furnish, in such detail as requested by CMHA, a breakdown of the total contract price showing the amount included therein for each principal category of the work, which shall substantiate the payment amount requested in order to provide a basis for determining progress payments.
- A. The breakdown shall be approved by CMHA and must be acceptable to HUD.
- B. If the contract covers more than one Project, the Contractor shall furnish a separate breakdown for each.
- C. The values and quantities employed in making up this breakdown are for determining the amount of progress payments and shall not be construed as a basis for additions to or deductions from the Contract Sum.
- D. The Contractor shall prorate its overhead and profit over the construction period of the Contract.
- 7.4.3. The Contractor shall submit, on forms provided by CMHA, periodic estimates showing the value of the work performed during each period based upon the approved breakdown of the Contract Sum.
- A. Such estimates shall be submitted not later than nine (9) calendar days in advance of the date set for payment and are subject to correction and revision as required.
- B. The estimates must be approved by the CMHA prior to payment.
- C. If the contract covers more than one project, the Contractor shall furnish a separate progress payment estimate for each.
- D. Each payment application should include affidavits for the Contractor, Sub Contractors and Material Suppliers. Lien waivers should be submitted as proof of payment for the prior payment application affidavits.
- 7.4.4. Along with each request for progress payments and the required estimates, the Contractor shall furnish the following certification, or payment shall not be made:
- A. I hereby certify, to the best of my knowledge and belief, that:
- i. The amounts requested are only for performance in accordance with the specifications, terms,
- ii. Payments to subcontractors and suppliers have been made from previous payments received under the contract, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements; and

- iii. This request for progress payments does not include any amounts which the prime Contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract.

7.5. Allowances

- 7.5.1. The Contract Sum includes the Allowances (if any) identified in the Contract.
- 7.5.2. All allowances include the costs to the Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes.

7.6. Unit Prices

- 7.6.1. Where the Contract provides that all or a part of the Work is to be Unit Price Work, initially that Contract Sum will include for all Unit Price Work:
 - A. An amount equal to the sum of the established Unit Prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Contract.
 - B. The Contractor's fee on that Unit Price Work.
- 7.6.2. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Sum.
 - A. CMHA will determine the actual quantities and classifications of Unit Price Work performed by the Contractor.
- 7.6.3. Before final payment, an appropriate Change Order will be issued to reconcile the Contract Sum so that it reflects actual amount due to the Contractor on account of Unit Price Work actually performed.

7.7. Schedule of Values

- 7.7.1. Within seven (7) calendar days after issuance of Letter of Intent or other period as mutually agreed by the Contractor and CMHA, the Contractor shall submit to CMHA a Schedule of Values on a form provided for by CMHA, with separate amounts shown for labor and materials for each branch of Work.
 - A. The Contractor shall clearly indicate on the Schedule of Values, but is not necessarily limited to, the cost of payment and performance bond(s), permit costs, the amount(s) allocated, including separate items for the Contractor's Fee (Overhead and Profit), and the amount(s) of labor and materials, as appropriate.
- 7.7.2. The grand total shown on the Schedule of Values shall equal the total Contract Sum.
- 7.7.3. CMHA may use the approved Schedule of Values to determine cost or credit to CMHA resulting from any change in the Work.
 - A. The first items shall be a breakdown of the General Conditions Cost.
 - B. The amounts for labor and materials shall accurately reflect the cost for each item.
 - i. The Contractor shall clearly indicate on the Schedule of Values, the amount(s) allocated, including separate items for Contractor's Fee (overhead and profit), for each Section 3 certified Business used in the performance of the Work.
 - ii. Contractor's Fee shall be included in the totals for labor and materials.
 - C. If the material allocation exceeds 55 percent of the Contract Sum, the Contractor shall provide, upon request, sufficient information to support the higher percentage.
 - D. Subcontract Work shall show amounts for labor and materials.
 - i. Fringe benefits shall be shown as a part of labor costs.
 - E. When more than one major structure is included in the Work, the Contractor shall subdivide the Schedule of Values accordingly, with cost details for each structure shown separately.
 - F. The line items shall be coordinated with line items in the Construction Progress Schedule, which may require division of items of Work by area of the Project by floor, phase, or other appropriate area.
 - G. Mechanical and electrical Work shall be included in separate line items for all major pieces of equipment, and group smaller equipment items by type.
 - H. Line items shall be included for each Allowance, Punch List Work, Project Record Document Submittals, delivery of attic stock, and specified demonstrations and training.
- 7.7.4. CMHA may return the Schedule of Values to the Contractor for re-submittal if it does not meet the requirements or contains insufficient items or details of the Work, or approve the Schedule of Values if CMHA determines that it conforms to section 7.7
- 7.7.5. No payment shall be made until the CMHA has approved the Contractor's Schedule of Values.

7.8. Labor Payments/Retainage

- 7.8.1.** Partial payments to the Contractor for labor performed under either a Unit Price or lump sum Contract shall be made at the rate of 90 percent of the amount invoiced through the Contractor Payment Request.

7.9. Material Payments/Retainage

- 7.9.1.** CMHA shall pay the Contractor at the rate of 100 percent of the scheduled value for materials incorporated into the Project.
- 7.9.2.** CMHA shall pay the Contractor at the rate of 90 percent of the invoice cost, not to exceed the scheduled value in a Unit Price or lump sum Contract, for materials delivered to the Site, or other off-Site storage location approved by CMHA provided the Contractor provides the following information with the Contractor Payment Request:
- A.** A list of the fabricated materials consigned to the Project, giving the place of storage, together with copies of invoices, in order to verify quantity and cost; and
 - B.** A certification of materials stored off-site, prepared by the Contractor and signed by CMHA to evidence that the materials are in conformity with the Specifications and have been tagged with the Project name and number for delivery to the Project.
- 7.9.3.** CMHA shall pay the balance of the scheduled value when the materials are incorporated into and become a part of the Project.
- 7.9.4.** When payment is allowed for materials delivered to the Site or other approved off-site storage location but not yet incorporated into the Project, the materials are the property of CMHA.
- 7.9.5.** CMHA may, at its sole discretion, retain any material not ultimately incorporated into the Project or return it to the Contractor for credit of an amount proportionate to the value of the extra materials.
- 7.9.6. Release of Retainage**
- A.** When the Contractor has achieved Substantial Completion of all Work, and there is no other reason to retain funds; upon request of the Contractor, the funds retained in connection with that Work shall be released and paid to the Contractor, withholding only that amount necessary to assure faithful completion in the sole discretion of CMHA, including but not limited to compliance with CLOSEOUT.

7.10. Payments Withheld

- 7.10.1.** CMHA may withhold funds from or may assess Liquidated Damages against a Contractor Payment Request.
- 7.10.2.** CMHA may decline to approve any Contractor Payment Request or part thereof, or nullify any previous Contractor Payment Request, in whole or in part, to the extent necessary in CMHA's sole opinion to protect CMHA from loss because of:
- A.** Defective Work not remedied;
 - B.** Overpayment of any schedule of values line item without prior approval of related change order by Contracting Officer;
 - C.** Overpayment due to calculation error;
 - D.** Damage caused by the Contractor;
 - E.** Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
 - F.** Reasonable evidence that the Work will not be completed within the Contract Times, and that the unpaid balance would not be adequate to cover damages under the Contract Documents for the anticipated delay;
 - G.** Failure to comply with Applicable Law including, but not limited to, the requirements of ORC.

7.11. Payment Request

- 7.11.1.** The Contractor and each of its Subcontractors, regardless of tier, shall execute a Payment Release Affidavit to certify that the Contractor and each of its Subcontractors, regardless of tier, have complied with all applicable requirements of ORC, and to certify that all of its Subcontractors have been paid in full for all Work performed or materials furnished under the Contract.
- 7.11.2.** CMHA shall pay Contractor in approximately forty-five (45) calendar days from the date of acceptance of the Payment Request.

- 7.11.3.** The Contractor, as a condition precedent to final payment, shall complete all requirements of the Contract Documents.
- 7.11.4.** Acceptance of final payment by the Contractor or a Subcontractor constitutes the payee's waiver of all claims against CMHA except those previously made in writing and identified by that payee as unsettled at the time of the final Contractor Payment Request.

8. ARTICLE VIII CONTRACT MODIFICATIONS

8.1. Changes in the Work

- 8.1.1.** Except as provided, no order, statement or conduct of CMHA shall be treated as a change or entitle the Contractor to an equitable adjustment.
- 8.1.2.** Only CMHA's Contracting Officer has authority to modify any term or condition of this Contract.
 - A.** Any Contract modification shall be authorized in writing.
- 8.1.3.** The Contracting Officer may modify the contract unilaterally:
 - A.** Pursuant to a specific authorization stated in a Contract clause; or
 - B.** For administrative matters which do not change the rights or responsibilities of the parties.
- 8.1.4.** All other Contract Modifications shall be in the form of supplemental agreements signed by the Contractor and CMHA.
 - A.** If notice of any change affecting the Contract is required by the provision of any Bond, notice is the Contractor's responsibility.
- 8.1.5.** Except as expressly stated herein, the Contractor's failure to obtain prior written authorization from CMHA for a change in the Work constitutes a waiver by the Contractor of an adjustment to the Contract Sum or Contract Time or both.
- 8.1.6.** The Contractor shall perform all changes in the Work under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly with the change unless otherwise provided in the Change Order or order for a minor change in the Work.
- 8.1.7. HUD Approval**
 - A.** When a proposed modification requires the approval of HUD prior to its issuance; such modification shall not be effective until the required approval is received by CMHA.

8.2. Change Order

- 8.2.1.** CMHA may order changes in the Work without invalidating the Contract and such change in Work may be accomplished, by Change Order or an order for a minor change in the Work.
- 8.2.2.** CMHA may, at any time, without notice to the sureties, by written order designated or indicated to be a change order, make changes in the Work within the general scope of the Contract including, but not limited to, changes:
 - A.** In the specifications (including drawings and designs);
 - B.** In the method or manner of performance of the Work;
 - C.** CMHA-furnished facilities, equipment, materials, services, or site; or
 - D.** Directing the acceleration of the Work.
- 8.2.3.** If any change causes an increase or decrease in the Contractor's cost of, or the time required for the performance of any part of the Work under this contract, whether or not changed by any such order, CMHA shall make an equitable adjustment and modify the Contract in writing.
 - A.** However, except for an adjustment based on defective specifications, no proposal for any change shall be allowed for any costs incurred more than twenty (20) calendar days before the Contractor gives written notice as required.
 - B.** In the case of defective specifications for which CMHA is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specification.
- 8.2.4.** The Contractor must assert its right to an adjustment within thirty (30) calendar days after:
 - A.** Receipt of a written change order, or
 - B.** The furnishing of a written notice by submitting a written statement describing the general nature and the amount of the proposal.
- 8.2.5.** If the facts justify it, CMHA may, in its sole discretion, extend the period for submission.

8.3. Change Order Directive

- 8.3.1.** A Change Order Directive is a written order prepared by CMHA directing a change in the Work and may, if necessary, state a proposed basis for adjustment, if any, of Contract Sum or Contract Time, or both.
- 8.3.2.** A Change Directive shall be used to direct a change in the Work in the absence of a total agreement on the terms of a Change Order and shall only be used in the absence of total agreement on the terms of a Change Order concerning the associated change of the Work.

- 8.3.3.** Upon receipt of a Change Directive, the Contractor shall promptly proceed with the change in the Work involved.
- 8.3.4.** Within fourteen (14) calendar days after receiving the Change Directive, the Contractor shall respond with a Change Order Proposal for adjustment of the Contract Sum or Contract Time or both.
- 8.3.5.** If the Contractor does not respond to the Change Directive as required above, CMHA shall determine the adjustments, if any, of the Contract Sum and Contract Times.
- A.** If the Contractor does not agree with CMHA's determination, the Contractor shall initiate a claim within ten (10) calendar days of the date on which CMHA issues the determination, and the Contractor's failure to do so shall constitute an irrevocable waiver the Claim.
- 8.3.6.** If CMHA and the Contractor agree on the adjustment of the Contract Sum and/or Contract Time associated with the Change Order Directive, CMHA shall prepare an appropriate Change Order.

8.4. Change Order Procedure

- 8.4.1.** Any Change Order Request must be in writing and submitted by the Contractor to CMHA in accordance with the Notice Provision.
- 8.4.2.** The Contractor's cost of preparing and providing Proposals is included in the Contract Sum.
- 8.4.3.** If CMHA Agrees with Change Order Proposal:
- A.** CMHA shall prepare each Change Order, attach the supporting documentation, and issue the Change Order to the Contractor for signature.
- B.** Within three (3) business days after issuance of Change Order to Contractor, Contractor must sign the Change Order and resubmit to CMHA.
- C.** Change Order is not approved until CMHA's Contracting Officer signs the Change Order.
- 8.4.4.** If CMHA disagrees with Change Order Proposal or Contracting Officer doesn't Approve Change Order:
- A.** CMHA will notify Contractor in writing with reasons; and
- B.** Contractor has fourteen (14) calendar days to modify the Change Order Request or invoke ARTICLE XI DISPUTE RESOLUTION/CLAIM PROCEDURE.
- 8.4.5.** Failure to reach an agreement on any proposal shall be a dispute under ARTICLE XI DISPUTE RESOLUTION/CLAIM PROCEDURE herein.
- A.** Nothing in Change Order Procedure, however, shall excuse the Contractor from proceeding with the contract change pursuant to an issued Change Directive.

8.5. Change Order Proposal

- 8.5.1.** The Contractor's written proposal for equitable adjustment shall be submitted in the form of a lump sum proposal supported with an itemized breakdown of all increases and decreases in the contract in at least the following details:
- A.** Direct Costs:
- i.** Materials (list individual items, the quantity and unit cost of each, and the aggregate cost)
- ii.** Transportation and delivery costs associated with materials
- iii.** Labor breakdowns by hours or unit costs (identified with specific Work to be performed)
- iv.** Construction equipment exclusively necessary for the change
- v.** Costs of preparation and/or revision to shop drawings resulting from the change
- vi.** Worker's Compensation and Public Liability Insurance
- vii.** Employment taxes under FICA and FUTA
- viii.** Bond Costs
- B.** Indirect Costs:
- i.** Indirect costs may include overhead, general and administrative expenses, and fringe benefits not normally treated as direct costs.
- C.** Profit:
- i.** The amount of profit shall be negotiated and may vary according to the nature, extent, and complexity of the work required by the change.
- ii.** The allow-ability of the direct and indirect costs shall be determined in accordance with the Contract Cost Principles and Procedures for Commercial Firms, in effect on the date of this Contract.
- iii.** The Contractor shall not be allowed a profit on the profit received by any subcontractor.

- iv. Equitable adjustments for deleted work shall include a credit for profit and may include a credit for indirect costs.
- v. On proposals covering both increases and decreases in the amount of the contract, the application of indirect costs and profit shall be on the net-change in direct costs for the Contractor or subcontractor performing the Work.

8.5.2. The Contractor shall include in the proposal its request for time extension (if any), and shall include sufficient information and dates to demonstrate whether and to what extent the change will delay the completion of the Contract in its entirety.

8.5.3. CMHA shall act on proposals within thirty (30) calendar days after their receipt, or notify the Contractor of the date such action will be taken.

8.5.4. By signing a Change Order, the Contractor irrevocably certifies that the elements of a Change Order described herein are completely satisfied, and waives all rights, if any, to seek further adjustment of the Contract Sum or Contract Times, or both, at a later date with respect to the associated change in the Work, including without limitation on account of the “cumulative impact” of the associated change in the Work in combination with in one or more of the other changes in the Work.

8.5.5. No Proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this Contract.

Except in an emergency endangering life or property, no change shall be made by the Contractor without a prior written authorization from CMHA’s Contracting Officer. When the Change Order is signed by the Contractor and CMHA’s Contracting Officer, the fully executed Change Order modifies the Contract Documents and authorizes and directs the Contractor to proceed, and the Contractor shall promptly proceed with the associated change in the Work.

8.6. Differing Site Conditions

8.6.1. The Contractor shall promptly, and before the conditions are disturbed, give a written notice to CMHA of:

- A. Subsurface or latent physical conditions at the site which differ from those indicated in this contract; or
- B. Unknown physical conditions at the site(s), of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the Contract.

i. Written notice of the condition shall be given immediately to CMHA.

C. The Contractor’s failure to give notice of the Differing Site Condition as required shall constitute an irrevocable waiver of any associated claim.

8.6.2. CMHA shall investigate the site conditions promptly after receiving the notice.

- A. Work shall not proceed at the affected site, except at the Contractor’s risk, until the Contracting Officer has provided written instructions to the Contractor.
- B. If the conditions do materially so differ and cause an increase or decrease in Contractor’s cost of, or the time required for, performing any part of the Work under this Contract, whether or not changed as a result of the conditions, the Contractor shall file a claim in writing to CMHA within ten (10) calendar days after receipt of such instructions and, in any event, before proceeding with the work.
- C. An equitable adjustment in the Contract price, the delivery schedule, or both shall be made under this.

8.6.3. No request by Contractor for an equitable adjustment to the Contract under Differing Site Conditions shall be allowed, unless the Contractor has given the written notice required; provided that the time prescribed for giving written notice may be extended by CMHA.

8.6.4. If CMHA determines that the Contractor has not encountered a Differing Site Condition and the Contractor does not agree with that determination, the Contractor must initiate a Claim within ten (10) calendar days of the date that CMHA issues its determination.

8.7. Minor Changes in the Work

8.7.1. CMHA may order minor changes in the Work not involving adjustment of the Contract Sum or extension of the Contract Times and not inconsistent with the intent of the Contract Documents.

- A. Those changes shall be effected by written order issued to the Contractor.

- 8.7.2.** The Contractor shall promptly carry out each order for a minor change in the Work if the Contractor agrees that the order does not involve adjustment of the Contract Sum and Contract Times.
- 8.7.3.** If the Contractor reasonably believes that it would be entitled to an adjustment of the Contract Sum or Contract Times, or both, on account of an order for a minor change in the Work, the Contractor, within three (3) business days after receiving the order, shall give CMHA written notice of the Contractor's position, and not proceed with the subject Work without first receiving a Change Order related to it.
- 8.7.4.** The Contractor waives its right to an adjustment of the Contract Sum or Contract Times on account of an order for a minor change in the Work by:
- A.** Starting the Work that is the subject of the order for a minor change in the Work; or
 - B.** Failing to give the notice described within three (3) business days after receiving the order for a minor change in the Work.

8.8. Change Order Cost or Credit Determination

8.8.1. General

- A.** The maximum cost or credit resulting from a change in the Work shall be determined as described below.
 - i.** Proposals shall include the information required.
 - ii.** A Unit Price Proposal shall only be valid when incorporated into the Contract by Change Order.
 - iii.** The maximum cost or credit includes all compensation for impact costs.
 - (a)** Additional costs for impacts shall not be allowed.
- B.** The Contractor shall not assign any portion of the Work to another Person whereby the Contractor would benefit directly or indirectly from the double application of charges for overhead or profit.
- C.** CMHA may require notarized invoices for material costs and may audit the records of the Contractor and Subcontractors.
- D.** For each change in the Work, the Contractor shall furnish a detailed Proposal itemized on the Proposal Worksheet Summary Form published by CMHA through which the Contractor shall document the related changes in the Contract Sum.
 - i.** Any Subcontractor pricing shall also be itemized on the Proposal Worksheet Summary Form.
- E.** Section 8.8.2 Pricing Criteria establishes the exclusive and maximum amount that CMHA shall pay for any Change Order, including, but not limited to, all amounts for interference with, delay, hindrance, disruption, or impact of the Work
 - i.** These Pricing Criteria also govern the value of deduct Change Orders and the Contractor's entitlement to additional compensation or damages through the Claims and dispute resolution processes on account of changes in the Work.
 - ii.** In order to expedite the review and approval process, Proposals shall be prepared in the categories and order listed in - Pricing Criteria.

8.8.2. Pricing Criteria

A. Contractor Personnel Costs

- i.** The Contractor's on-Site management (including supervision and administrative personnel) are not subject to State or Federal Prevailing Wage Rates.
- ii.** These costs will be calculated on an hourly basis according to the rates acceptable to CMHA.
- iii.** In no event will the Contractor be entitled to an increase in the Contract Sum on account of Contractor Personnel Costs unless the Contractor actually incurs additional Contractor Personnel Costs solely on account of the associated change in the Work.

B. Labor

- i.** Field labor directly involved in the Work based upon the actual rate of pay to the worker.
- ii.** If the Project is subject to payment of prevailing wage rates, field labor shall be paid according to the applicable classification of labor as established in the applicable prevailing wage determination.
- iii.** In no event will the Contractor be entitled to an increase in the Contract Sum on account of labor costs unless the Contractor actually incurs additional labor costs solely on account of the associated change in the Work.

- iv. Under no conditions will the increase exceed those additional labor costs the Contractor actually incurs.
 - v. The cost for supervision above the level of working forepersons (such as general forepersons, superintendent, project manager, etc.) is included in the adjustment Contractor Personnel Costs.
- C. Fringes**
- i. Fringe benefit credit for labor is only allowable for prevailing wage fringe benefits including, but not limited to, Health and Welfare, vacation, apprenticeship training, and certain types of pension plans.
 - ii. Each fringe benefit for which credit is requested shall be calculated on an hourly basis and listed as a separate line item.
 - iii. The Contractor shall submit documentation supporting the calculation of the amounts for each fringe benefit for each worker classification, including labor provided by Subcontractors.
- D. Allowable Payroll Expenses**
- i. Allowable payroll expenses for labor including payroll taxes as well as other benefits that are required by Applicable Law, shall each be a separate line item.
- E. Equipment Rentals**
- i. All charges for certain non-owned heavy or specialized equipment at up to 100 percent of the documented rental cost
 - ii. No rental charges shall be allowed for hand tools, minor equipment, simple scaffolds, etc. Downtime due to repairs, maintenance and weather delays shall not be allowed.
 - iii. Contractor shall submit copies of actual paid invoices to substantiate rental costs.
- F. Owned Equipment**
- i. All charges for certain heavy or specialized equipment owned by the Contractor or Subcontractor performing the Work at up to 100 percent of the cost listed by the current edition of the Associated Equipment Distributors' *AED Green Book* heavy equipment rental rates.
 - ii. No recovery shall be allowed for hand tools, minor equipment, simple scaffolds, etc.
 - iii. The longest period of time that the equipment is to be required for the Work shall be the basis for the pricing.
 - iv. Downtime due to repairs, maintenance, and weather delays shall not be allowed.
- G. Trucking**
- i. A reasonable delivery charge or per-mile trucking charge for delivery of required materials or equipment
 - ii. Charges for use of a pick-up truck shall not be allowed.
- H. Materials**
- i. The actual cost (including all discounts, rebates or related credits) of all materials incorporated into the changed Work
 - ii. Documentation shall show costs, quantities, or Unit Prices of all items, as appropriate.
 - iii. The cost or credit for reusable materials shall be limited to 33 percent of the material cost for each use.
- I. Contractor's General Conditions Costs**
- i. The Contractor's General Conditions Costs to the extent attributable to an associated change in the Contract Time for achievement of Final Acceptance resulting from the change in Work
 - ii. In no event shall the Contract Sum adjustment per day of Contract Time adjustment exceed an amount equal to **(1)** the sum of the General Conditions Costs line items in the Contractor's Schedule of Values approved by CMHA, **(2)** divided by the total number of days of the original Contract Time for achievement of Final Acceptance.
 - iii. The Contractor shall:
 - (a)** Exclude the bond premium from the Schedule of Values for the purposes of the calculation; and
 - (b)** Include the actual adjustment of the Bond Premium attributable to an associated change in the Contract Sum.
 - iv. If the Contractor purchases Builder's Risk insurance for the Project, the Contract shall:

- (a) Exclude the Builder's Risk insurance premium from the Schedule of Values for the purposes of the calculation; and
- (b) Include the actual adjustment of the Builder's Risk insurance premium attributable to an associated change in the Contract Sum.

J. Subcontractor Overhead and Profit

- i. Adjustment of the Contract Sum on account of a change in Subcontractor-performed Work shall include the Subcontractor's aggregate overhead and profit allowance equal to 15 percent of the sum of the Subcontractor's costs that are associated with that changed Work.
- ii. The allowance applies to each Subcontractor tier.
- iii. The allowance covers:
 - (a) The costs required to schedule and coordinate the Work
 - (b) Telephone
 - (c) Telephone charges
 - (d) Facsimile
 - (e) Telegrams
 - (f) Postage
 - (g) Photos
 - (h) Photocopying
 - (i) Hand tools
 - (j) Simple scaffolds (one level high)
 - (k) Tool breakage
 - (l) Tool repairs
 - (m) Tool replacement
 - (n) Tool blades
 - (o) Tool bits
 - (p) Home office estimating and expediting
 - (q) Home office clerical and accounting support
 - (r) Home office labor (management, supervision, engineering)
 - (s) All other home office expense, legal services, travel, and parking expenses
- iv. An exception is allowed for shop or engineering labor, which shall not be subject to Prevailing Wage rates for steel fabricators, sheet metal fabricators, and sprinkler system fabricators performing work off-site.
 - (a) Recovery for these matters shall be allowed on an hourly basis.
- v. An exception is allowed for field supervision labor, for those portions of the Change Order Work that will be performed, or was performed, at times when the superintendent is not required to be on site, including but not limited to overtime hours due to acceleration and\ extensions of the Contract Times.
 - (a) Recovery for this matter will be allowed on an hourly basis.

K. Contractor's Fee

- i. Adjustment of the Contract Sum on account of a change in the Work shall include an allowance for the Contractor's Fee equal to 10 percent of the sum of the costs that are associated with that changed Work.

L. Miscellaneous

- i. Adjustment of the Contract Sum on account of a change in Work may include the following costs with no allowance for Contractor's Fee or Subcontractor overhead and profit.
- ii. The premium portion only for approved overtime (labor and fringes)
- iii. The straight time portion is included.

8.8.3. Costs that shall not be reimbursed for Change Order Work include the following

- A. Voluntary employee deductions including, but not limited to, deductions for charitable donations or U.S. savings bonds
- B. Employee profit sharing

8.9. Time Extension

- 8.9.1.** Every adjustment of the Contract Times associated with any change in the Work shall be determined as provided herein, which establishes the Contractor's maximum entitlement for any change in the Work, including without limitation all adjustments for interference, delay, hindrance, or disruption of the Work.
- 8.9.2.** This also governs time adjustments for deduct Change Orders and the Contractor's entitlement to additional time through the claims and dispute resolution processes on account of changes in the Work.
- 8.9.3.** The Contractor shall substantiate all changes in the Contract Times with:
- A.** A written description of the nature of the interference, disruption, hindrance or delay;
 - B.** Identification of Persons and events responsible for the interference, disruption, hindrance or delay;
 - C.** Date, or anticipated date, of commencement of the interference, disruption, hindrance or delay;
 - D.** Identification of activities by schedule activity number and name on the Construction Progress Schedule, which may be affected by the interference, disruption, hindrance or delay, or new activities created by the interference, disruption, hindrance or delay and the relationship with existing activities;
 - E.** Anticipated duration of the interference, disruption, hindrance or delay and of any remobilization period;
 - F.** Specific number of days of extension requested and specific number of days for remobilization requested;
 - G.** Recommended action to avoid or minimize any future interference, disruption, hindrance or delay; and
 - H.** A detailed written proposal for an increase in the Contract Sum which would fully compensate the Contractor for all costs of acceleration of the Work needed to completely overcome the associated delay, if any.
- 8.9.4.** A Change Order may authorize extension of the Contract Time for specific elements, while maintaining milestone dates for unaffected elements.
- A.** Such a Change Order may also authorize an appropriate adjustment to Liquidated Damages.
- 8.9.5. Critical Path**
- A.** Time extensions shall depend upon the extent to which the Work on the critical path of the Construction Progress Schedule is affected.
- 8.9.6.** A Change Order granting a time extension may provide that the Contract Times shall be extended for only elements so interfered with, disrupted, hindered, or delayed and related remobilization and that shall not be altered and may further provide for adjustment of Liquidated Damages.

9. ARTICLE IX CONSTRUCTION CLOSEOUT

9.1. Final Cleaning

- 9.1.1.** Before requesting the Substantial Completion inspection of the Work, the Contractor shall clean the Site, remove waste materials and rubbish attributable to the Project, and restore the property to an acceptable condition so that upon Substantial Completion, the premises are ready for occupancy by CMHA.
- 9.1.2.** If the Contractor performs any Work after final cleaning, the Contractor shall clean the affected area as provided above so that upon Substantial Completion, the premises are ready for occupancy by CMHA.
- 9.1.3.** Final cleaning shall be done to the reasonable satisfaction of CMHA.

9.2. Inspection and Construction of the Work

- 9.2.1.** The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the Contract conforms to contract requirements.
 - A.** All work is subject to CMHA inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract.
- 9.2.2.** CMHA inspections and tests are for the sole benefit of CMHA and do not:
 - A.** Relieve the Contractor of responsibility for providing adequate quality control measures;
 - B.** Relieve the Contractor of responsibility for loss or damage of the material before acceptance;
 - C.** Constitute or imply acceptance; or
 - D.** Affect the continuing rights of CMHA after acceptance of the completed work.
- 9.2.3.** The presence or absence of the CMHA inspector does not relieve the Contractor from any Contract requirement, nor is the inspector authorized to change any term or condition of the specifications without the Contracting Officer's written authorization.
 - A.** All instructions and approvals with respect to the work shall be given to the Contractor by CMHA.
- 9.2.4.** The Contractor shall promptly furnish, without additional charge, all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by CMHA.
 - A.** CMHA may charge to the Contractor any additional cost of inspection or test when work is not ready at the time specified by the Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary.
 - B.** CMHA shall perform all inspections and tests in a manner that will not unnecessarily delay the work. Special, full size and performance tests shall be performed as described in the Contract.

9.3. Routine Inspections

- 9.3.1.** CMHA may conduct routine inspections of the construction Site on a daily basis.
- 9.3.2.** The Contractor shall, without charge, replace or correct Work found by CMHA not to conform to contract requirements, unless Contracting Officer decides that it is in its interest to accept the Work with an appropriate adjustment in Contract Sum.
 - A.** The Contractor shall promptly segregate and remove rejected material from the premises.
- 9.3.3.** If the Contractor does not promptly replace or correct rejected Work, CMHA may:
 - A.** By Contract or otherwise, replace or correct the Work and charge the cost to the Contractor; or
 - B.** Terminate for default the Contractor's right to proceed.
- 9.3.4.** If any work requiring inspection is covered up without approval of CMHA, it must, if requested by the Contracting Officer, be uncovered at the expense of the Contractor.
 - A.** If at any time before final acceptance of the entire work, CMHA considers it necessary or advisable, to examine work already completed by removing or tearing it out, the Contractor, shall on request, promptly furnish all necessary facilities, labor, and material.
 - B.** If such Work is found to be defective or nonconforming in any material respect due to the fault of the Contractor or its subcontractors, the Contractor shall defray all the expenses of the examination and of satisfactory reconstruction.
 - C.** If, however, such work is found to meet the requirements of the Contract, the Contracting Officer shall make an equitable adjustment to cover the cost of the examination and reconstruction, including, if completion of the work was thereby delayed, an extension of time.

9.4. Substantial Completion**9.4.1. Contractor's Punch List**

- A.** When the Contractor considers the Work, or a designated portion thereof, Substantially Complete the Contractor shall inspect the Work and prepare a list of Defective Work and incomplete or unacceptable Work ("Contractor's Punch List").
- B.** The Contractor shall list all items of Work not in compliance with the Contract Documents, including items the Contractor is requesting to be deferred.
 - i.** The Contractor shall proceed to correct all items listed on the Contractor's Punch List and certify that the incomplete items listed on the Contractor's Punch List are to its knowledge an accurate and complete list by signing the Contractor's Punch List.
 - ii.** The Contractor's failure to include an item on the Contractor's Punch List shall not alter the Contractor's responsibility to complete the Work in accordance with the Contract Documents.
 - iii.** The Contractor shall submit the signed Contractor's Punch List to CMHA together with a request for a Substantial Completion inspection of the Work.

9.4.2. Substantial Completion Inspection

- A.** The Contractor shall notify CMHA, in writing, as to the date when in its opinion all or a designated portion of the Work will be substantially completed and ready for inspection.
 - i.** If CMHA and/or the A/E determine that the state of preparedness is as represented, CMHA will promptly arrange for the inspection.
 - ii.** Unless otherwise specified in the Contract, CMHA shall accept, as soon as practicable after completion and inspection, all work required by the Contract or that portion of the Work that CMHA determines and designates can be accepted separately.
 - iii.** Acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or CMHA's right under any warranty or guarantee.
- B.** Within three (3) business days after receipt of the request for the Substantial Completion inspection of the Work, CMHA shall notify the Contractor of acceptance or rejection of the request, stating reasons for any rejection.
 - i.** Within seven (7) calendar days after its acceptance of the Contractor's request, CMHA and/or the A/E shall conduct the Substantial Completion inspection to determine whether the Work, or designated portion, is in conformity with the Contract Documents and Substantially Complete.
 - ii.** If CMHA and/or the A/E determines that the Work is Substantially Complete, within three (3) business days after the Substantial Completion inspection, CMHA and/or the A/E shall prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion and include a list of Defective, incomplete, or unacceptable Work ("CMHA's Punch List").
 - iii.** CMHA's Punch List shall include:
 - (a)** The items on the Contractor's Punch List that are not yet completed or corrected as of the date of the Substantial Completion inspection; and
 - (b)** Comments from CMHA regarding the Punch List and other issues related to the Project.
 - iv.** CMHA shall submit the Certificate of Substantial Completion to the Contractor for their written acceptance.
 - (a)** Upon their acceptance and consent of the Contractor's Surety, and subject to CMHA's right to withhold payment, CMHA shall release retainage.
 - v.** CMHA and/or the A/E's failure to include an item on CMHA's Punch List shall not alter the Contractor's responsibility to complete the Work in accordance with the Contract Documents.
 - vi.** If CMHA subsequently determines that the Work is not Substantially Complete, CMHA may request compensation for related expenses.
 - (a)** CMHA may deduct the additional expenses from payments then or thereafter due the Contractor.

- (b) If payments then or thereafter due the Contractor are not sufficient to cover those amounts, the Contractor shall immediately pay the amount of the insufficiency to CMHA. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA, from and against all claims, (whether alleged or proven), demands, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, associated with the failure of the Contractor to timely and properly complete the Punch List items.

9.4.3. Completion of Punch List Items

- A. The Contractor shall complete all items on the CMHA's Punch List prior to date for Contract Completion.
- B. After completing all items on the CMHA's Punch List, the Contractor shall provide a written request for Final Inspection of the Work.
 - i. If Work on the Punch List cannot be timely completed, the Contractor shall submit a change order request MODIFICATIONS.
 - ii. Within three (3) business days after receipt of the request for the Final Inspection of the Work, CMHA and/or the A/E shall complete a Final Inspection of the Work for compliance with the Contract Documents.
 - iii. If multiple inspections of items on CMHA's Punch List are required due to the Contractor's failure to properly and timely complete them, the Contractor shall pay any additional costs incurred by the A/E and CMHA resulting from any attendant delay.
 - (a) CMHA may deduct those additional costs from payments then or thereafter due the Contractor.
 - (b) If payments then or thereafter due the Contractor are not sufficient to cover those amounts, the Contractor shall immediately pay the amount of the insufficiency to CMHA. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA, from and against all claims, (whether alleged or proven), demands, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, related to multiple inspections by CMHA of items on the Punch List due to the Contractor's failure to properly and timely complete the Punch List.

9.5. Demonstration and Training, Operating Appurtenances

- 9.5.1. The Contractor, as a condition precedent to execution of the Certificate of Contract Completion and final payment, shall perform demonstration and training of CMHA's maintenance personnel as specified in the Contract Documents.
- 9.5.2. The Contractor, as a condition precedent to execution of the Certificate of Contract Completion and final payment, shall organize and submit operating appurtenances and loose items related to operation and maintenance of the completed Project to CMHA, including, but not limited to:
 - A. Keys to door and window hardware, panels, and other devices not directly provided to CMHA from the manufacturer;
 - B. Operating handles, levers, cranks, specialized wrenches or drivers, remote controls, and similar items; and
 - C. Extra materials (e.g., attic stock).

9.6. Acceptance of Defective Work

- 9.6.1. Defective Work may only be knowingly accept by CMHA in writing instead of CMHA requiring its removal or correction, in which case the Contract Sum must be equitably reduced to account for the reduction in benefit of the Work received by CMHA on account of the Defective Work.
 - A. CMHA may only accept Defective Work though a deduct Change Order that makes explicit reference to Acceptance of Defective Work
- 9.6.2. None of the following will constitute acceptance of Defective Work, a release of the Contractor's obligation to perform the Work in accordance with the Contract, or a waiver of any rights set forth in the Contract or otherwise provided by Applicable Law:

- A. Observations or inspections by CMHA or the A/E;
- B. The making of any payment;
- C. Substantial Completion or the issuance of a Certificate of Substantial Completion;
- D. Partial Occupancy and CMHA's use or occupancy of the Work or any part of it;
- E. Contract Completion or the issuance of a partial or final Certificate of Contract Completion;
- F. Any review or approval of a submittal;
- G. Any inspection, test, or approval by other Persons; or
- H. Any correction of Defective Work by CMHA.

9.7. Building Commissioning

- 9.7.1.** If the Project scope includes building commissioning, the Contractor shall participate in the Commissioning Process, as prescribed in the Contract Documents.
- 9.7.2.** The Contractor shall permit the A/E, CMHA, or a third-party Commissioning Agent ("CxA") if applicable, access to commission performance based equipment, fixtures, and/or systems (e.g., HVAC, fire protection, smoke evacuation, fume hoods, emergency power, etc.), prior to Substantial Completion.
- 9.7.3.** The A/E, CMHA, or CxA if applicable, shall promptly notify, in writing, the Contractor of any deficiency identified during the Commissioning Process.
- 9.7.4.** To facilitate the Commissioning Process, the Contractor shall submit 4 sets of Operation and Maintenance manuals for dynamic and engineered systems to CMHA and CxA, if applicable, for approval. This submission shall occur within 30 days of obtaining approval of all related Contractor submittals required by the Contract Documents.

9.8. Contract Completion

9.8.1. Partial Contract Completion

- A. When items of Work cannot be completed until a subsequent date, CMHA shall prepare a partial Certificate of Contract Completion that shall include a detailed list of the deferred Work and the date(s) by which the Contractor will complete that Work.
- B. CMHA shall submit the partial Certificate of Contract Completion to Contractor for their written acceptance. Upon their acceptance of the partial Certificate of Contract Completion and consent of the Contractor's Surety, CMHA may release payment to the Contractor, as determined in the sole discretion of CMHA.

9.8.2. Final Contract Completion

- A. Contract Completion shall occur no later than 30 calendar days from the date of Substantial Completion.
- B. When all items on CMHA's Punch List have been completed to the satisfaction of CMHA, all requirements of the Contract Documents have been completed, and the provisions have been fulfilled, CMHA shall prepare and recommend execution of final Contract payment.
- C. The date that CMHA executes the final Certificate of Contract Completion or issues Contract payment, whichever is later, is the date of Contract Completion.
- D. Nothing in Contract Completion shall constitute a waiver of CMHA's ability to pursue damages as the result of any breach of the Contract by the Contractor or Liquidated Damages.

10. ARTICLE X SUSPENSION AND TERMINATION**10.1. Suspension of the Work**

- 10.1.1.** The Contracting Officer may order the Contractor in writing to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of CMHA.
- 10.1.2.** If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted by an act of CMHA in the administration of this Contract, or by CMHA's failure to act within the time specified (or within a reasonable time if not specified) in this Contract, an adjustment shall be made for any increase in the cost of performance of the Contract (excluding profit) necessarily caused by such unreasonable suspension, delay, or interruption and the Contract modified in writing accordingly.
- A.** However, no adjustment shall be made for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor or for which any equitable adjustment is provided for or excluded under any other provision of this Contract.
- 10.1.3.** A Claim shall not be allowed:
- A.** For any costs incurred more than twenty (20) calendar days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order); and
- B.** Unless the Claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but no later than the date of final payment under the Contract.
- 10.1.4.** If CMHA suspends the Work under ARTICLE X SUSPENSION AND TERMINATION and the Contractor submits a proper Payment Request, subject to all other provisions of the Contract Documents, the Contractor shall be entitled to payment of compensation due under the Contract Documents for the Work performed before the suspension based upon the Schedule of Values.
- 10.1.5.** CMHA, without prejudice to any other right or remedy it may have, may order the Contractor in writing to suspend, delay, or interrupt the performance of the Work in whole or in part for such period as CMHA may determine for any of the following reasons:
- A.** Defective Work;
- B.** The Contractor is causing undue risk of damage to any part of the Project or adjacent area;
- C.** The Contractor fails to furnish or perform the Work in such a way that the complete Work will conform to the requirements of the Contract Documents; or
- D.** Any other cause CMHA reasonably believes justifies suspension.
- i.** CMHA's exercise of its right to suspend the Work shall not entitle Contractor to any adjustment of the Contract Sum, Contract Time or both.
- 10.1.6.** Upon receipt of the notice of suspension, the Contractor shall cease Work on the suspended activities and take all necessary or appropriate steps to limit disbursements and minimize respective costs.
- A.** The Contractor shall furnish a report to CMHA within five (5) business days of receiving the notice of suspension, describing the status of the Work, including, but not limited to, results accomplished, resulting conclusions, and other information as CMHA may require.
- 10.1.7.** CMHA's right to stop the Work shall not give rise to any duty to exercise the right for the benefit of the Contractor or any other party, and CMHA's exercise or failure to exercise the right shall not prejudice any of CMHA's other rights including the right to suspend the Work in the future under the same or similar circumstances.
- 10.2. Termination for Convenience**
- 10.2.1.** CMHA, through the Contracting Officer, may terminate this contract in whole, or in part, whenever the Contracting Officer determines that such termination is in the best interest of CMHA.
- A.** Any such termination shall be effected by delivery to the Contractor of a Notice of Termination specifying the extent to which the performance of the work under the contract is terminated, and the date upon which termination becomes effective.

- 10.2.2.** Upon delivery of the notice of termination for convenience, the Contractor shall immediately proceed with performance of the following duties in accordance with instructions from CMHA:
- A.** Cease operations as specified in the notice;
 - B.** Place no further orders and enter into no further subcontracts for materials, labor, services, or facilities, except as necessary to complete continued portions of the Project;
 - C.** Terminate all subcontracts and orders to the extent they are related to the Work terminated;
 - D.** Proceed with Work not terminated; and
 - E.** Take actions that may be necessary, or that CMHA may direct, for the protection and preservation of the terminated Work.
 - i.** Failure to do so may lead to Contractor's liability for actual damages as a result of Contractor's failure to protect the Work.
- 10.2.3.** If the performance of the work is terminated, either in whole or in part, CMHA shall be liable to the Contractor for reasonable and proper costs resulting from such termination upon the receipt by CMHA of a properly presented claim setting out in detail:
- A.** The total cost of the work performed to date of termination less the total amount of contract payments made to the Contractor;
 - B.** The cost of settling and paying claims under Subcontracts and material orders for work performed and materials and supplies delivered to the site, payment for which has not been made by CMHA to the Contractor or by the Contractor to the Subcontractor or supplier;
 - C.** The cost of preserving and protecting the work already performed until CMHA or assignee takes possession thereof or assumes responsibility therefore; and
 - D.** An amount constituting a reasonable profit on the value of the work performed by the Contractor.
- 10.2.4.** CMHA will act on the Contractor's claim within sixty (60) calendar days (unless CMHA deems in writing that additional time is needed for review) of receipt of the Contractor's claim.
- 10.2.5.** Any disputes are expressly made subject to the provisions of this Contract.

10.2.6. If CMHA terminates the Work the termination shall not affect the rights or remedies of CMHA against the Contractor then existing or which may thereafter accrue.

10.2.7. Notwithstanding, if CMHA terminates the Work but there exists an event of Contractor's default, the Contractor shall be entitled to receive only such amounts as it would be entitled to receive following the occurrence of an event of default as provided for below.

10.3. Termination for Cause/Default

10.3.1. If the Contractor materially breaches this Contract, including without limitation, the Contractor refuses or fails to prosecute the work, or any separable part thereof, with the diligence that will insure its completion within the time specified in this Contract, or any extension thereof, or fails to complete said work within this time, CMHA may, by written notice to the Contractor, terminate the right to proceed with the work (or separable part of the work) that has been delayed.

- A.** In this event, CMHA may take over the work and complete it, by contract or otherwise, and may take possession of and use any materials, equipment, and plant on the work site necessary for completing the work.
- B.** The Contractor and its sureties shall be liable for any damage to CMHA resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated.
 - i.** This liability includes any increased costs incurred by CMHA in completing the Work.
- C.** Other examples of material breaches of the Contract include but are not limited to:
 - i.** Refusal to remedy defective work;
 - ii.** Failure to supply enough properly skilled workers or proper materials;
 - iii.** Failure to provide revised Construction Progress Schedule or Recovery Plan;
 - iv.** Failure to properly make payment to Subcontractors or Consultants; or
 - v.** Disregarding laws, ordinances, or rules, regulations, or orders of a public authority with jurisdiction over the Project.

10.3.2. If CMHA intends to exercise its termination right, CMHA shall issue not less than five (5) business days written notice to the Contractor and the Contractor's Surety in accordance with ORC.

- A.** Notwithstanding any provision of the Contract to the contrary, the issuance of a 3-Day Notice is not a condition precedent to CMHA's exercise of its rights and CMHA's decision to not issue a 3-Day Notice will not prejudice CMHA's rights under this.

10.3.3. If the Contractor fails to satisfy the requirements set forth in the 5-Day Notice within fifteen (15) calendar days of receipt of the 5-Day Notice or as otherwise specified in the notice, CMHA may declare the Contractor in default, terminate the Contract, and employ upon the Work the additional force or supply materials or either as appropriate, and remove Defective Work.

10.3.4. If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the Parties will be the same as if the termination had been for convenience of CMHA.

10.3.5. If the Contract is terminated, the Contractor's Surety may perform the Contract.

- A.** If the Contractor's Surety does not commence performance of the Contract within ten (10) calendar days of the date of Contract termination, CMHA may complete the Work by means that CMHA deems appropriate.
 - i.** CMHA may take possession of and use all materials, facilities, and equipment at the Site or stored off-site, for which CMHA has paid.
- B.** If CMHA notifies the Contractor's surety that the Contractor is in default or terminates the Contract, the surety will promptly and in not less than twenty-one (21) calendar days investigate the claimed material default or termination.
 - i.** If CMHA gives a notice of default and then terminates the Contract, the surety shall complete its investigation within twenty-one (21) calendar days of the notice of default.
 - (a)** As part of such investigation, the surety shall visit the offices of the Contractor, A/E and CMHA to review the available project records.

- ii. If the surety proposes to take over the Work, the surety shall do so no later than the expiration of such 21-day period or ten (10) calendar days after the date CMHA terminates the Contract, whichever is later.
 - iii. If CMHA terminates the Work, and the surety proposes to provide a replacement contractor, the replacement contractor shall be fully capable of performing the Work in accordance with the Contract Documents, including meeting all the requirements of the Contract Documents.
 - (a) If the Contractor is terminated, the replacement contractor shall not be the Contractor.
 - iv. The surety will provide the Owner with the results of its investigation, including any written report or documents.
- C. Termination for Cause/Default is in addition to CHMA's other rights under the Contract Documents and is not intended to create any rights of the surety, including but not limited to the right to take over the Contractor's obligations.
- 10.3.6.** If the Contract is terminated for cause, the Contractor shall not be entitled to further payment.
- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA, from and against all claims, (whether alleged or proven), demands, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, arising out of or related the costs incurred by CMHA to finish the Work following termination of the Contractor for cause.
 - B. If the unpaid balance of the Contract Sum exceeds the costs of finishing the Work, including without limitation the fees and charges of engineers, architects, attorneys, and other professionals and court costs, and other damages incurred by CMHA and not expressly waived, the Contractor or Surety shall immediately pay the amount of insufficiency to CMHA.
 - C. This obligation for payment shall survive termination of the Contract.
- 10.3.7.** If the Contractor's Surety performs the Work, the provisions of the Contract Documents govern the Surety's performance, with the Surety in place of Contractor in all provisions including, but not limited to, provisions for payment for the Work, and provisions of the right of CMHA to complete the Work.
- 10.3.8.** If CMHA terminates the Contract, the termination shall not affect any rights or remedies of CMHA against the Contractor then existing or which may thereafter accrue.
- A. CMHA's retention or payment of funds due to the Contractor shall not release the Contractor or the Contractor's Surety from liability for performance of the Work in accordance with the Contract Documents.
- 10.4. Contractor Insolvency**
- 10.4.1. Bankruptcy of Contractor**
- A. If the Contractor files a voluntary petition in bankruptcy or has an involuntary petition in bankruptcy filed against it, the Contractor, the Contractor as the debtor-in-possession, or the trustee of the Contractor's bankruptcy estate shall notify CMHA in writing within five (5) days of such filing and file a motion to assume or reject the Contract within twenty (20) calendar days after the filing of the petition and shall diligently prosecute that motion to conclusion so as to obtain an order granting or denying that motion within forty-five (45) calendar days after the filing of the petition.
 - B. The failure of the Contractor to file and prosecute that motion Contractor shall constitute a material breach of the Contract by the Contractor as time is of the essence with respect to Contractor's performance of all terms of this Contract.
 - C. The Contractor agrees to the granting of relief from the automatic stay of the Bankruptcy Code, to permit CMHA to terminate the Contract for cause in such instance and issue and serve all notices necessary to terminate the Contract or arising out of termination of the Contract and to take any other action necessary to terminate the Contract.
- 10.4.2. Receivership or Assignment for the Benefit of Creditors**

- A.** If the Contractor makes a general assignment for the benefit of creditors or if a receiver is appointed for all or a substantial part of Contractor's business or property, CMHA shall serve written notice to the Contractor and Contractor's Surety stating that any failure of the Contractor to provide adequate assurance of continued performance shall be considered a rejection of the Contract, which shall result in termination of the Contract for cause.
- B.** Termination of the Contract need not be evidenced by an order of any court.

11. ARTICLE XI DISPUTE RESOLUTION/CLAIM PROCEDURE**11.1. General**

- 11.1.1.** "Claim," as used in ARTICLE XI DISPUTE RESOLUTION/CLAIM PROCEDURE, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, additional time, the adjustment or interpretation of contract terms, or other relief arising under or relating to the contract.
- 11.1.2.** A Claim arising under the Contract, unlike a claim relating to the contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant.
- 11.1.3.** A voucher, invoice, application for payment, or other routine request for payment that is permitted under the Contract Documents and is not in dispute when submitted, is not a Claim.
- 11.1.4.** The submission may be converted to a Claim by complying with the requirements of ARTICLE XI DISPUTE RESOLUTION/CLAIM PROCEDURE, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.
- 11.1.5.** Except for disputes arising under ARTICLE XIX LABOR STANDARDS, herein, all disputes arising under or relating to this contract, including any claims for damages for the alleged breach thereof which are not disposed of by agreement, shall be resolved under ARTICLE XI DISPUTE RESOLUTION/CLAIM PROCEDURE.
- 11.1.6.** All Claims by the Contractor shall be made in writing and submitted to CMHA for a written decision.
 - A.** A claim by CMHA against the Contractor shall be subject to a written decision by the Contracting Officer.

11.2. Initiation of a Claim

- 11.2.1.** Every Claim shall accrue upon the date of occurrence of the event giving rise to the Claim.
- 11.2.2.** Except as provided, the Contractor shall initiate every Claim by giving written notice of the Claim to CMHA within ten (10) calendar days after occurrence of the event giving rise to the Claim, with the following exceptions:
 - A.** The 10-day time limit on initiating a Claim arising from the response of an RFI by CMHA begins to run on the date of the response.
 - B.** The 10-day time limit on initiating a Claim arising from CMHA's determination concerning a Differing Site Condition begins to run on the date of the determination.
- 11.2.3.** The Contractor's written notice of a Claim shall provide the following information:
 - A.** Nature and anticipated amount of the impact, including all costs for any interference, disruption, hindrance, or delay, which shall be calculated and be a fair and reasonably accurate assessment of the damages suffered or anticipated by the Contractor;
 - B.** Identification of the circumstances responsible for causing the impact, including, but not limited to, the date or anticipated date, of the commencement of any interference, disruption, hindrance, or delay;
 - C.** Identification of activities on the Construction Progress Schedule that will be affected by the impact or new activities that may be created and the relationship with existing activities;
 - D.** Anticipated impacts and anticipated duration of any interference, disruption, hindrance, delay, or impact, and any remobilization period; and
 - E.** Recommended action to avoid or minimize any interference, disruption, hindrance, delay, or impact.
- 11.2.4.** The Contractor's failure to initiate a Claim as and when required shall constitute the Contractor's irrevocable waiver of the Claim.

11.3. Substantiation of Claims General

- 11.3.1.** Within thirty (30) calendar days after the initiation of a Claim, the Contractor shall submit three (3) copies of all information and statements required to substantiate a Claim and all other information that the Contractor believes substantiates the Claim.
- 11.3.2.** The Contractor shall substantiate all of its Claims by providing the following minimum information:
 - A.** A narrative of the circumstances, which gave rise to the Claim, including without limitation the start date of the event or events and the actual or anticipated finish date;
 - B.** Detailed identification of the Work affected by the event giving rise to the Claim;
 - C.** Copies of the Contractor's daily log for each day of impact;

- D. Copies of relevant correspondence and other information regarding or supporting Contractor's entitlement;
- E. Copies of any and all information related to the Contractor's costs, including all job cost reports, bid take offs, and other financial information related to the Contractor's Claim;
- F. The notarized Certification of a Claim

11.4. Substantiation of Claims for increase of the Contract Sum

11.4.1. In addition to the minimum information required by Contractor, the Contractor shall substantiate each Claim for an increase of the Contract Sum with:

- A. Written documentation of the actual additional direct and indirect costs to the Contractor due to the event giving rise to the Claim;
- B. A written statement from the Contractor that the increase requested is the entire increase in the Contract Sum associated with the Claim; and
- C. The general substantiation documentation.

11.5. Substantiation of Claims for Extension of the Contract Time

11.5.1. In addition to the minimum information required by Contractor, the Contractor shall substantiate each Claim for an extension of the Contract Times with:

- A. Written documentation of the actual delay to the critical path of the Construction Progress Schedule due to the event giving rise to the Claim;
- B. A detailed written Proposal for an increase in the Contract Sum that would fully compensate the Contractor for all costs of acceleration of the Work needed to completely overcome the associated delay, A written statement from the Contractor that the extension requested is the entire extension of the Contract Times associated with the Claim; and
- D. The general substantiating documentation.

11.5.2. In addition, if adverse weather conditions are the basis for a Claim for additional time, the Contractor shall document the Claim with data substantiating that weather conditions were abnormal for the period, could not have been reasonably anticipated, and had an adverse effect on a critical element of the scheduled construction.

11.6. Certification of a Claim

11.6.1. The Contractor shall certify each Claim within thirty (30) calendar days after initiating the Claim or before Contract Completion, whichever is earlier, by providing the notarized Certification of a Claim specified below, signed and dated by the Contractor:

- A. *"The undersigned Contractor certifies that the Claim is made in good faith; that the supporting data is accurate and complete to the best of the Contractor's knowledge and belief; that the amount requested is a fair, reasonable, and necessary adjustment for which the Contractor believes that CMHA is liable; and that the undersigned is duly authorized to certify the Claim on behalf of the Contractor."*

11.7. Delay and Delay Damage Limitations

11.7.1. Subject to other provisions of the Contract, the Contractor will be entitled to an extension of the Contract Times on account of delay in the commencement or progress of Work on the critical path of the Construction Progress Schedule caused by acts of unforeseeable Nature or the public enemy, acts of the government not arising from the Contractor's failure to comply with Applicable Law, fires, floods, epidemics, weather, and labor disputes beyond the Contractor's control.

11.7.2. Notwithstanding any other provision of the Contract Documents to the contrary, the Contractor shall not be entitled to an increase in the Contract Sum, or an extension of the Contract Times, or both:

- A. On account of the impact of any normal adverse weather on any of the Work or on account of the impact of any abnormal adverse weather on Work not on the critical path;
- B. To the extent that a delay occurs concurrently with a delay attributable to the Contractor; or
- C. On account of the delay of any Work not on the critical path.
 - i. When the Contractor is prevented from completing any part of the Work on the critical path within the Contract Time due to weather conditions, provided the Contractor properly initiates a Claim, the Contract Time will be extended by one (1) day for each work day lost due to weather that delays Work on the critical path in excess of those in the following table:

Month	Number of Workdays Lost Due To Weather
January	8
February	8
March	7
April	6
May	5
June	4
July	4
August	4
September	5
October	6
November	6
December	6

11.7.3. Notwithstanding any other provision of the Contract Documents to the contrary, the Contractor shall not be entitled to an increase in the Contract Sum or any type of damages on account of a delay in the commencement or progress of Work on the critical path unless:

- A. The delay is caused by CMHA; and
- B. The delay was not authorized or permitted under the Contract.

11.7.4. Notwithstanding any other provision of the Contract Documents to the contrary, the Contractor shall not be entitled to an increase in the Contract Sum or any type of damages arising from a delay in the commencement or progress of any the Work caused by the occurrence or non-occurrence of an event beyond CMHA's control such as acts of Nature or the public enemy, acts of the government, fires, floods, epidemics, labor disputes, unusual delivery delays, weather, or damages caused by the Contractor.

11.8. Derivative Claims

11.8.1. Notwithstanding any other provision of the Contract to the contrary, if CMHA prosecutes a claim, suit, or appeal against a Separate Consultant or Separate Contractor to recover damages the Contractor suffers on account of the acts or neglects of a Separate Consultant or Separate Contractor or person or entity for whom either is legally responsible, CMHA's liability to the Contractor shall not exceed the amount CMHA actually recovers from the Separate Consultant or Separate Contractor on account of those damages less the costs CMHA incurs recovering them. CMHA is not obligated to prosecute any such claim, suit, or appeal.

11.9. Claim Decision

11.9.1. CMHA shall, within sixty (60) calendar days (unless otherwise requested), decide Claims submitted by Contractor or notify the Contractor of the date by which the decision will be made.

11.9.2. The Contracting Officer's decision shall be final with respect to Claims by Contractor unless the Contractor:

- A. Appeals in writing to a higher level at CMHA in accordance with the CMHA's policy and procedures;
- B. Refers the appeal to an independent mediator or arbitrator; or
- C. Files suit in a court of competent jurisdiction. Such suit must be filed within fifteen (15) calendar days (unless a different time period is identified in the Claim Decision) after receipt of CMHA's decision.

11.9.3. The Contractor shall proceed diligently with performance of this Contract, pending final resolution of any request for relief, Claim, appeal, or action arising under or relating to the Contract, and comply with any decision of CMHA.

11.10. Audit of a Claim

11.10.1. All Claims submitted by Contractor shall be subject to audit at any time following filing of the Claim by Contractor, whether or not the Claim is part of any lawsuit.

11.10.2. The audit may be performed by employees of CMHA or by a consultant engaged by CMHA.

11.10.3. The audit may begin upon 10-days' notice to the affected Contractor or affected Subcontractor.

11.10.4. The Contractor shall cooperate with the request.

11.10.5. **Failure of the Contractor or Subcontractor to produce sufficient records to allow CMHA to audit and verify a Claim shall constitute an irrevocable waiver of the Claim or portion of the Claim that could not be completely audited.**

- 11.10.6.** The Contractor shall make available to CMHA all Contractor and Subcontractor documents related to the Claim including, without limitation, the following documents:
- A. Daily time sheets and superintendent's daily reports;
 - B. Union agreements, if any, and employer agreements;
 - C. Insurance, welfare, fringes, and benefits records;
 - D. Payroll tax returns;
 - E. Material invoices, purchase orders, Subcontracts, and all material and supply acquisition contracts;
 - F. Material cost distribution worksheets;
 - G. Equipment records (list of Contractor equipment, rates, etc.);
 - H. Vendor rental agreements and Subcontractor invoices;
 - I. Subcontractor payment certificates;
 - J. Canceled checks (payroll and vendors);
 - K. Job cost report;
 - L. Job payroll ledger;
 - M. General ledger, general journal, (if used) and all subsidiary ledgers and journals together with all supporting documentation pertinent to entries made in these ledgers and journals;
 - N. Cash disbursements journal;
 - O. Financial statements for all years reflecting operations on the Project;
 - P. Income tax returns for all years reflecting operations on the Project;
 - Q. Depreciation records on all equipment utilized whether the records are maintained by the Contractor, its accountant, or others;
 - R. If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all other source documents;
 - S. All documents that reflect the Contractor's actual profit and overhead during the years the Project was being performed;
 - T. All documents related to the preparation of the Contractor's Bid, including the final calculations on which the Bid was based, unless the documents are placed in escrow under provisions of the Instructions to Bidders;
 - U. All documents that relate to the Claim together with all documents that support the amount of damages as to the Claim;
 - V. Worksheets used to prepare the Claim establishing the cost components for items of the Claim including, but not limited to, labor, fringes, benefits and insurance, materials, equipment, Subcontractors, and all documents that establish the periods of time, individuals involved, the hours and rate of pay for the individuals; and
 - W. All other documents required by CMHA to reasonably review the Claim.
- 11.11. False Certification of a Claim**
- 11.11.1.** If the Contractor falsely certifies all or any part of a Claim, the portion of the Claim falsely certified shall be denied, and may be sufficient cause for CMHA to exclude Contractor from future contracting opportunities as permitted by law.
- 11.11.2.** The Contractor shall not knowingly present or cause to be presented to the Owner a false or fraudulent Claim.
- A. Knowingly shall have the same meaning as in [the Federal False Claims Act](#).
- 11.11.3.** If the Contractor knowingly presents or causes to be presented a false or fraudulent Claim, then the Contractor shall be liable to the Owner for the same civil penalty and damages as the United States Government would be entitled to recover and shall also indemnify and hold the Owner harmless from all costs and expenses, including Owner's attorneys' and consultants' fees and expenses incurred in investigating and defending against such Claim and in pursuing the collection of such penalty, damages and fees and expenses.

12. ARTICLE XII WARRANTY**12.1. Warranty of Title**

- 12.1.1.** The Contractor warrants good title to all materials, supplies, and equipment incorporated in the Work and agrees to deliver the premises together with all improvements thereon free from any claims, liens or charges, and agrees further that neither it nor any other person, firm or corporation shall have any right to a lien upon the premises or anything appurtenant thereto.

12.2. Warranty of Construction

- 12.2.1.** In addition to any other warranties in this Contract, the Contractor warrants that work performed under this contract conforms to the Contract requirements and is free of any defect in equipment, material, or workmanship performed by the Contractor or any Subcontractor or supplier at any tier.
- A.** Work not conforming to those requirements, including Substitutions not properly approved and authorized, may be considered Defective Work.
- B.** If required by CMHA, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.
- 12.2.2.** The Contractor shall remedy, at the Contractor's expense, any Work that does not conform to the requirements of the Contract Documents, or any Defective Work.
- A.** In addition, the Contractor shall remedy, at the Contractor's expense, any damage to CMHA-owned or controlled real or personal property when the damage is the result of:
- i.** Any action or inaction by Contractor;
 - ii.** The Contractor's failure to conform to Contract requirements; or
 - iii.** Any defects of equipment, material, workmanship or design furnished by the Contractor.
- 12.2.3.** The Contractor shall restore any work damaged in fulfilling the terms and conditions of Warranty of Construction.
- A.** The Contractor's Warranty with respect to work repaired or replaced shall be extended for a period of not less than one year, beyond the original Warranty period required under the Contract, of repair or replacement.
- 12.2.4.** CMHA shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect or damage.
- A.** If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, CMHA shall have the right to replace, repair or otherwise remedy the failure, defect, or damage at the Contractor's expense.
- 12.2.5.** With respect to all warranties, express or implied, from Subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall:
- A.** Obtain all warranties that would be given in normal commercial practice;
 - B.** Require all warranties to be executed in writing, for the benefit of CMHA; and
 - C.** Enforce all warranties for the benefit of CMHA.
- 12.2.6.** If the Contractor or a Subcontractor recommends a particular product, material, system, or item of equipment for incorporation into the Project and CMHA accepts that recommendation, the above Warranty shall include a warranty from the Contractor to CMHA that the recommended product, material, system, or item of equipment is fit and appropriate for the associated purpose.
- 12.3. Warranty Walk-through Contractor**
- 12.3.1.** At CMHA's request, Contractor shall perform a walkthrough of the property no earlier than three months prior to the expiration of any Warranty.
- A.** If Contractor is unavailable for the Warranty walk-thru, the Warranty shall be extended until the time Contractor is available.

13. ARTICLE XIII BONDS**13.1. Bid Bond/Guaranty**

- 13.1.1.** The Contractor shall provide to CMHA a Bid Guaranty in the form of either:
- A.** A Bond for 10% of the Bid; or
 - B.** A certified check, cashier's check or letter of credit revocable only at the option of CMHA and shall be in the amount of 10% of the Bid.
- 13.1.2.** The Bid Guaranty shall be conditioned to:
- A.** Provide that Contractor will, after award, enter into a contract with CMHA in accordance with the bid, plans, details, and specifications.
 - B.** If the Bidder fails to enter into the Contract and CMHA awards Contract to next lowest bidder, the Bidder and the Surety on the Bidder's Bid are liable to CMHA for the lesser of either:
 - i.** The difference between the Bidder's Bid amount and the bid amount of the next lowest bidder; or
 - ii.** For a penal sum of the Bond in the amount of 10% of the Bidder's Bid.
 - C.** If CMHA does not award the Contract to the next lowest bidder but resubmits the Project for bidding, the Bidder failing to enter into the Contract and the Surety on the Bidder's Bond are liable to CMHA for a penal sum on the Bond not to exceed 10% of the amount of the Bidder's Bid amount.
- 13.1.3.** Where CMHA accepts a Bid but the Bidder fails or refuses to enter into a Contract in accordance with the Contract Documents included with the Bid, including the plans, details, and specifications, within ten (10) calendar days after Notice of Intent, the Bidder and Surety on any Bond are liable for the amount of the difference between the amount of the Bidder's Bid and the amount of the Bid from next lowest Bidder.
- 13.1.4.** All Bid Guaranties shall be payable to CMHA, be for the benefit of CMHA and be deposited with CMHA.

13.2. Payment and Performance Bond

- 13.2.1.** In addition to any other requirements in the Contract Documents, Contract Commencement does not occur until CMHA receives a Payment and Performance Bond.
- 13.2.2.** Contractor shall, within ten (10) calendar days of CMHA's delivery of signed Contract to Contractor, unless otherwise specified by CMHA in writing, deliver to CMHA a payment and performance bond with a penal sum in the amount of 100% of the Contract Sum (which includes all acceptable alternates).
- 13.2.3.** The Payment and Performance Bond shall contain the following a condition that indemnifies CMHA against all damages suffered by CMHA as a result of the failure of Contractor to perform the Work in accordance with the requirements of the Contract Documents, including, the plans, details, and specifications, and the Payment and Performance Bond shall state that Contractor shall pay all lawful claims of Subcontractors, material suppliers, and laborers for labor performed or material furnished in carrying forward, performing or completing the Contract.
- 13.2.4.** All Bonds requirement by the Contract shall be obtained from companies holding certificates of authority as acceptable sureties and shall be listed on the U.S Treasury Circular 570 (T-List).
- A.** Each company shall be licensed to do business in Ohio and satisfactory to CMHA.
- 13.2.5.** The Contractor shall submit with each executed Bond:
- A.** A certified copy of the authority to act (power of attorney) of the agent signing the Bond on behalf of the Surety, and
 - B.** A current signed Certificate of Compliance issued by the Ohio Department of Insurance demonstrating that Surety is licensed to do business in Ohio.
- 13.2.6.** If the Contract Sum increases at any time such that it exceeds the sum of the Bond, the Contractor shall cause the penal sum of the Bond to be increased such that the sum equals one-hundred percent of the increased Contract Sum.
- 13.2.7.** Any time Contractor increases the sum of the Bond, the Contractor shall deliver to CMHA written consent of the affected Surety confirming the increased penal sum of the Bond.
- A.** CMHA's receipt of that written consent is a condition precedent to CMHA's obligation to pay the Contractor for any portion of the Work associated with the increase.
- 13.2.8.** If notice of any change affecting the Contract is required by any Surety or by the provision of any Bond, the Contractor shall provide that notice.

14. ARTICLE XIV INSURANCE

14.1. Contractor's General Insurance Requirements

- 14.1.1.** Throughout the performance of the Work or longer as may be described below, the Contractor and each Subcontractor shall obtain, pay for and keep in force, the minimum insurance coverage.
- 14.1.2.** On a case-by-case basis, CMHA and Contractor may mutually agree to adjust the insurance requirements for any particular subcontractor.
- 14.1.3.** All insurance shall be carried with companies which are financially responsible and admitted to do business in the State of Ohio.
 - A.** If any such insurance is due to expire prior to Contract Completion, the Contractor (including Subcontractors, as applicable) shall not permit the coverage to lapse and shall furnish evidence of coverage to the Contracting Officer.
 - B.** All certificates of insurance, as evidence of coverage, shall provide that no coverage may be canceled or non-renewed by the insurance company until at least thirty (30) calendar days prior written notice has been given to CMHA.

14.2. Minimum Coverage Requirements

14.2.1. Workers' Compensation:

- A.** In accordance with the State of Ohio Workers' Compensation laws

14.2.2. Commercial General Liability

- A.** With a combined single limit for bodily injury and property damage of not less than \$1,000,000 per occurrence unless otherwise specified by CMHA in writing, to protect the Contractor and each subcontractor against claims for bodily injury or death and damage to the property of others.
- B.** This shall cover the use of all equipment, hoists, and vehicles on the site(s) not covered by Automobile Liability.
- C.** If the Contractor has a "claims made" policy, then the following additional requirements apply:
 - i.** The policy must provide a "retroactive date" which must be on or before the execution date of the Contract; and
 - ii.** The extended reporting period may not be less than five years following the completion date of the Contract.

14.2.3. Employers Liability Coverage

- A.** Unless otherwise specified by CMHA in writing, the Contractor shall maintain employer's liability coverage with:
 - i.** An each accident limit of not less than \$1,000,000;
 - ii.** A disease each-employee limit of not less than \$1,000,000; and
 - iii.** A disease policy limit of not less than \$1,000,000.

14.2.4. Automobile Liability

- A.** On owned and non -owned motor vehicles used on the site(s) or in connection therewith for a combined single limit for bodily injury and property damage of not less than \$ 1,000,000 per occurrence.

14.2.5. Builder's Risk Insurance

- A.** Before commencing Work, the Contractor shall furnish CMHA with a certificate of insurance evidencing that **Builder's Risk** (fire and extended coverage) **Insurance** on all work in place and/or materials stored at the building site(s), including foundations and building equipment, is in force.
 - i.** The Builder's Risk Insurance shall be for the benefit of the Contractor and CMHA as their interests may appear and each shall be named in the policy or policies as an insured.
 - ii.** The Contractor if installing equipment supplied by CMHA shall carry insurance on such equipment from the time the Contractor takes possession thereof until the Contract work is accepted by CMHA.
 - iii.** The Builder's Risk Insurance need not be carried on excavations, piers, footings, or foundations until such time as work on the superstructure is started.
 - iv.** It need not be carried on landscape work.

- v. Policies shall furnish coverage at all times for the full cash value of all completed construction, as well as materials in place and/or stored at the site(s), whether or not partial payment has been made by CMHA.
 - vi. The Contractor may terminate this insurance on buildings as of the date CMHA issues a Certificate of Contract Completion.
- B. The amount of Builder's Risk coverage shall not be less than the total completed value of the Project, including the value of permanent fixtures and decorations, with a deductible of not more than \$25,000 per occurrence.
 - i. Contractor shall be responsible for paying all deductibles for any and all claims made under the Builder's Risk policy; and,
 - ii. Any deductible over the amount specified in this provision shall be authorized in writing by CMHA.
- C. Coverage shall include a provision to pay the reasonable extra costs of acceleration and expediting temporary and permanent repairs to, or permanent replacement of, damaged property.
 - i. This shall include overtime wages and the extra costs of "express" or other means of expedited transportation and/or delivery of supplies necessary to the repair or replacement.
- D. Coverage shall include "soft costs endorsement" including, but not limited to, the reasonable extra costs of the A/E and reasonable Contractor extension or acceleration costs.
- E. Coverage shall include material in transit or stored in off-site and identified for the Project.
- F. Coverage shall waive all rights between CMHA, Contractor, and Subcontractors at any tier, for damages caused by fire or any other perils to the extent of actual recovery of any insurance proceeds under the policy.
- G. Coverage shall include appropriate sub-limits for installation coverage.
- H. Coverage shall include provisions for mechanical or electrical breakdown, or boiler system testing.
- I. Coverage shall include temporary structures and scaffolding, along with collapse coverage.
- J. Coverage shall be primary to all other applicable insurance.
- K. The Builder's Risk policy shall specifically permit partial occupancy by CMHA prior to Contract Completion and coverage shall remain in effect until CMHA issues a Certificate of Contract Completion.
- L. The Contractor's tools and equipment shall not be covered under the Builder's Risk policy.
 - i. It is the Contractor's sole responsibility to maintain insurance coverage for tools and equipment used on the Project, which shall be included in its Overhead (a component of Contractor's Fee) and not included as a separate item in Contractor's Schedule of Values.
- M. If Contractor is involved solely in the installation of material and equipment and not in new building construction, the Contractor shall purchase and maintain a Builder's Risk, Builder's Risk-renovations, or installation floater insurance policy that complies with the requirements of Article XIV.

14.2.6. Umbrella/Excess Liability

- A. The Contractor may employ an umbrella/excess liability policy to achieve the above required minimum coverage.
- B. Unless otherwise specified by CMHA in writing, for Construction Contracts in excess \$1,000,000, the Contractor shall maintain umbrella/excess liability coverage with a limit of not less than \$2,000,000 (in addition to the above-required limits) if the Work (or Work to be performed by the Subcontractor) includes any of the following:
 - i. Brick/block masonry;
 - ii. Exterior caulking/sealant;
 - iii. Cast-in-place or precast concrete;
 - iv. Damp proofing/waterproofing;
 - v. Electrical;
 - vi. Elevator;
 - vii. Exterior glass and/or glazing;
 - viii. Exterior marble, granite, and/or other stonework;
 - ix. Miscellaneous metals;
 - x. Plaster/stucco;

- xii. HVAC;
 - xiii. Roofing and/or sheet metal;
 - xiv. Scaffolding;
 - xv. Spray-on fireproofing;
 - xvi. Sprinkler and/or fire protection; or
 - xvii. Structural steel and/or metal deck.
- C. Unless otherwise specified by CMHA in writing, the Contractor shall maintain umbrella/excess liability coverage with a limit of not less than \$5,000,000 (in addition to the above-required limits) if the Work (or the Work to be performed by the Subcontractor) includes any of the following:
 - i. Caissons and/or piles;
 - ii. Major Demolition;
 - iii. Excavation and/or utility work;
 - iv. Sheeting, shoring, and/or underpinning;
 - v. Window washing equipment; or
 - vi. Wrecking.

14.2.7. Professional Liability – Contractor

- A. Unless otherwise specified by CMHA in writing, the Contractor shall maintain professional liability insurance (including without limitation for sprinkler and/or fire protection and other design-build work included in the Work) without design-build exclusions with a limit not-less than \$1,000,000 each claim and an annual-aggregate limit of not less than \$2,000,000.
- B. The professional liability policy shall have an effective date on or before the date that the Contractor first started to provide any Project-related services.
- C. Upon submission of the associated certificate of insurance and at each policy renewal, the Contractor shall advise CMHA in writing of any actual or alleged claims that may erode the professional liability limits.
- D. The Contractor shall maintain the professional liability insurance in effect for no less than 5 years after the earlier of the termination of the Contract or Substantial Completion of all Work.

14.2.8. Additional Property Insurance

- A. For any demolition, blasting, excavating, tunneling, shoring, or similar operations, the Contractor shall provide and maintain Property Damage Liability insurance with a limit of liability equal to the limit as specified in the applicable provisions of ARTICLE XIV INSURANCE.

14.2.9. Equipment Coverage

- A. CMHA will not insure or be liable for damage to any Contractor or Subcontractor owned, leased, rented, or borrowed tools, equipment, or vehicles.
- B. The Contractor and Subcontractors are solely responsible for maintaining all insurance necessary to cover their tools, equipment, and vehicles.

14.3. Waivers of Subrogation

- 14.3.1.** To the fullest extent permitted by applicable laws, the Contractor waives all rights against CMHA and its agents and employees for damages to the extent covered by any insurance, except rights to the proceeds of that insurance.
 - A. All policies shall accomplish the waiver of subrogation by endorsement or otherwise.
- 14.3.2.** CMHA and Contractor waive all rights against each other for damages caused by fire or other perils to the extent actual recovery of any insurance proceeds under any property insurance or Builder's Risk insurance applicable to the Work.

15. ARTICLE XV INDEMNIFICATION

- 15.1.** To the fullest extent permitted by Applicable Law, the Contractor shall indemnify, defend, and hold harmless the Indemnified Parties from and against all claims, costs, damages, losses, fines, penalties, and expenses (including but not limited to all fees and charges of attorneys and other professionals, and all court, arbitration, or other dispute-resolution costs) arising out of or in connection with the Project.
- 15.2.** The Contractor's indemnification obligation under ARTICLE XV INDEMNIFICATION exists regardless of whether or not and the extent to which the claim, damage, loss, fine, penalty, or expense is caused by a party indemnified under ARTICLE XV INDEMNIFICATION.
- 15.2.1.** Nothing in ARTICLE XV INDEMNIFICATION obligates the Contractor to indemnify any individual or entity from and against the consequences of that individual or entity's own negligence.
- 15.3.** The Contractor's obligations under ARTICLE XV INDEMNIFICATION shall not extend to the liability of the A/E, A/E's consultants, agents, representatives, or employees for negligent preparation or approval of Drawings, Specifications, Change Orders, opinions, and other responsibilities of the A/E, except to the extent covered by the Contractor's insurance.
- 15.4.** In claims against an Indemnified Party by any direct or indirect employee (or the survivor or personal representative of that employee) of the Contractor or a person or entity for whom the Contractor may be liable, the indemnification obligation under ARTICLE XV INDEMNIFICATION will not be limited by a limitation on the amount or type of damages, compensation, or benefits payable under workers' compensation acts, disability benefit acts, or other employee benefits acts.
- 15.5.** The Contractor's indemnification obligation under ARTICLE XV INDEMNIFICATION will survive termination of the Contract and Date for Contract Completion.
- 15.6.** CMHA may deduct from the Contract Sum any claims, losses, fines, penalties, and expenses for which the Contractor is liable under ARTICLE XV INDEMNIFICATION.
- 15.6.1.** If those claims, damages, losses, fines, penalties and expenses exceed the unpaid balance of the Contract Sum, the Contractor shall immediately pay the difference to CMHA.

16. ARTICLE XVI DAMAGES

16.1. Liquidated Damages

- 16.1.1.** If the Contractor fails reach Substantial Completion within the Contract Time for Substantial Completion, including any properly approved extension for the Contract Time for Substantial Completion, the Contractor shall pay to CMHA as Liquidated Damages, the sum of **\$400.00** for each day of delay.
- A.** Liquidated Damages for the Date for Contract Completion and any Milestone Dates in the Contract, not including Substantial Completion, shall be assessed on in accordance
 - B.** To the extent that the Contractor's delay or non-performance is excused under another clause in this Contract, Liquidated Damages shall not be due CMHA.
 - C.** The Contractor remains liable for damages caused other than by delay.
- 16.1.2.** If CMHA terminates the Contractor's right to proceed, the resulting damage will consist of Liquidated Damages incurred until the Date of Contract Completion, together with any increased costs incurred by CMHA in completing the Work.
- 16.1.3.** If CMHA does not terminate the Contractor's right to proceed, the resulting damage will consist of Liquidated Damages incurred until the Date of Contract Completion.
- 16.1.4.** If the Contractor fails to achieve a Milestone Date, excluding the Date for Substantial Completion, within the associated Contract Time, the Contractor shall (at CMHA's option) pay to or credit CMHA the Liquidated Damages per day sum determined according to the following schedule for each day that the Contractor fails to achieve a Milestone within the associated Contract Time.

Contract Sum	Liquidated Damages per day
Less than \$100,000	\$200
From \$100,000 to \$500,000	\$400
From \$500,000.01 to \$1,000,000	\$500
From \$1,000,000.01 to \$3,000,000	\$750
More than \$3,000,000	\$1,000

- 16.1.5.** If the Contractor simultaneously fails to achieve two or more Milestones, including the Date for Substantial Completion, CMHA shall be entitled to recover the sum of the associated Liquidated Damages per day rates.
- 16.1.6.** The Liquidated Damages described are only intended to compensate CMHA for the direct damages it incurs as a result of the Contractor's failure to achieve the Milestones, including the Date for Substantial Completion, within their associated Contract Times.
- 16.1.7.** The Liquidated Damages described are not intended to compensate CMHA for any damages CMHA incurs on account of:
- A.** Any claims attributable to the Contractor that are brought by others including Separate Consultants and Separate Contractors; or
 - B.** Any failure of the Contractor to timely, properly, and completely perform the Contract other than the failure to achieve the Milestones, including the Date for Substantial Completion, within their associated Contract Times.
- 16.1.8.** The parties acknowledge that the above-listed Liquidated Damages per day sums are not penalties, and they each irrevocably waive the right (if any) to challenge the validity and enforceability of those Liquidated Damages per day sums.
- A.** Notwithstanding any other provision of the Contract Documents to the contrary, if a court determines that the Liquidated Damages per day sums or their application are void and unenforceable, CMHA shall be entitled to recover the actual damages that it incurs on account of the Contractor's failure to achieve the Date for Substantial Completion and/or one or more of the Milestones within the applicable Contract Times.
- 16.1.9.** In addition to other rights that CMHA may have relative to the Liquidated Damages, CMHA may deduct the Liquidated Damages from the Contract Sum as the damages accrue.

- A. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall immediately pay the amount of the insufficiency to CMHA. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA, from and against all claims, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, associated with the failure of the Contractor to timely and properly reimburse CMHA for any Liquidated Damages.

16.2. Mutual Waiver of Consequential Damages

- 16.2.1.** Except as provided Liquidated Damages, CMHA and Contractor each waive against the other all Claims for consequential damages that may arise out of or relate to this Contract.

- A. CMHA's waiver includes Claims for loss of use, income, profit, revenue, financing, cost of capital, business and reputation, management and employee productivity, and consequential damages arising from termination of the Contract or related to insolvency.
- B. The Contractor's waiver includes:
 - i. Claims for unabsorbed home-office overhead;
 - ii. Any other form of overhead in excess of that specifically provided for;
 - iii. Delay damages except as otherwise specifically provided for;
 - iv. Increased cost of funds for the Project;
 - v. Lost opportunity to work on other projects;
 - vi. Losses of financing, business, and reputation;
 - vii. Loss of profit except anticipated profit, arising directly from properly performed Work;
 - viii. Loss of bonding capacity; and
 - ix. Consequential damages arising from termination of the Contract or related to insolvency.

16.2.2. Notwithstanding Section 16.2.1, this Section 16.2:

- A. Does not apply to any damages that would be covered by insurance provided in connection with the Project if the Contract did not include Section 16.2.1 ;
- B. Does not apply to the Contractor's indemnity obligations for third-party claims against the Indemnified Parties even if those claims are for damages that Section 16.2.1 would otherwise preclude;
- C. Does not preclude CMHA's recovery of Liquidated Damages; and
- D. Does not apply to Claims for damages arising from CMHA's or the Contractor's gross negligence or willful misconduct.

16.3. This ARTICLE 16 shall survive termination of the Contract.

17. ARTICLE XVII EQUAL OPPORTUNITY**17.1. Prohibition Against Discrimination**

17.1.1. During the performance of this Contract, the Contractor agrees as follows:

- A.** Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, or handicap.
- B.** The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, national origin, or handicap.
 - i.** Such action shall include, but not be limited to:
 - (a)** Employment;
 - (b)** Upgrading;
 - (c)** Demotion;
 - (d)** Transfer
 - (e)** Recruitment or recruitment advertising;
 - (f)** Layoff or termination;
 - (g)** Rates of pay or other forms of compensation; and
 - (h)** Selection for training, including apprenticeship.
- C.** The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by CMHA that explain ARTICLE XVII EQUAL OPPORTUNITY.
- D.** The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor; state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, or handicap.
- E.** The Contractor shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or workers' representative of the Contractor's commitments under ARTICLE XVII EQUAL OPPORTUNITY, and post copies of the notice in conspicuous places available to employees and applicants for employment.
- F.** The Contractor shall comply with [Executive Order 11246, as amended](#), and the rules, regulations, and orders of the Secretary of Labor.
- G.** The Contractor shall furnish all information and reports required by [Executive Order 11246, as amended](#), [the Rehabilitation Act of 1973, as amended](#), and by rules, regulations, and orders of the Secretary of Labor, pursuant thereto.
 - i.** The Contractor shall permit access to its books, records, and accounts by the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
- H.** In the event of a determination that the Contractor is not in compliance with ARTICLE XVII EQUAL OPPORTUNITY or any rule regulations, or order of the Secretary of Labor, this contract may be canceled, terminated or suspended in whole or in part, and the Contractor may be declared ineligible for further Government Contracts, or Federally assisted construction contracts under the procedures authorized, in [Executive Order 11246, as amended](#).
 - i.** In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in [Executive Order 11246, as amended](#), the rules, regulations, and orders of the Secretary of Labor, or as otherwise provided by law, including the following as provided by ORC:
 - (a)** In the event Contractor fails to comply with these nondiscrimination provisions, CMHA shall deduct from the amount payable to the Contractor a forfeiture of the statutory penalty pursuant to ORC for each person who is discriminated against or intimidated.
 - (b)** The Contract may be terminated or suspended in whole or in part by CMHA and all money due hereunder may be forfeited in the event of a subsequent violation of the foregoing nondiscrimination provisions.
 - (c)** The Contractor shall include the terms and conditions of ARTICLE XVII EQUAL OPPORTUNITY in every Subcontract or purchase order unless exempted by the rules, regulations, or orders of the Secretary of Labor under [Executive Order 11246, as amended](#), so that these terms and conditions will be binding upon each Subcontractor or vendor.

- (d) The Contractor shall take such action with respect to any subcontract or purchase order as the Secretary of Housing and Urban Development or the Secretary of Labor may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the Contractor may request the United States to enter into the litigations to protect the interests of the United States.
- I. Compliance with the requirements of ARTICLE XVII EQUAL OPPORTUNITY shall be to the maximum extent consistent with, but not in derogation of compliance with the Indian Self-Determination and Education Assistance Act and the Indians Preference clause of this Contract.
- J. The Contractor shall cooperate fully with the States Equal Opportunity Coordinator (EOC), with any other official or agency of the state or federal government that seeks to eliminate unlawful employment discrimination, and with all other state and federal efforts to assure equal employment practices under the Contract.

18. ARTICLE XVIII SECTION 3

- 18.1.** In order to promote Employment, Job Training and Contracting Opportunities to low- and very low-income persons, the Contractor shall adhere to HUD's and CMHA's Section 3 Program requirements.
- 18.2.** The Work to be performed under this Contract is subject to the provisions of Section 3 of the Housing and Urban Development Act of 1968, as amended.
- 18.2.1.** The purpose of Section 3 is to ensure that employment and other economic opportunities generated by Federal financial assistance for housing and community development programs HUD assistance or HUD-assisted projects covered by Section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons particularly persons who are recipients of HUD assistance for housing.
- 18.3.** The parties to this Contract agree to comply with HUD's regulations in [24 CFR](#) § 75, which implement Section 3.
- 18.3.1.** As evidence by the execution of the Contract, the parties to this Contract certify that they are under no contractual or other impediments that would prevent them from complying with the regulations.
- 18.4.** The Contractor agrees to send to each labor organization or representative of workers with which the Contractor has a collective bargaining agreement or other understanding, if any, a narrative advising the labor organization or workers' representative of the Contractor's commitments, and will post copies of this notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice.
- 18.4.1.** The notice shall describe the preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s) taking applications for each of the positions; and the anticipated date the work will begin.
- 18.5.** The Contractor agrees to include ARTICLE XVIII SECTION 3 in every subcontract subject to compliance with regulations in [24 CFR](#) § 75, and agrees to take appropriate action, as provided in an applicable provision of the Subcontract or in ARTICLE XVIII SECTION 3, upon a finding that the Subcontractor is in violation of the regulations in [24 CFR](#) § 75.
- 18.5.1.** The Contractor will not Subcontract with any Subcontractor where the Contractor has notice or knowledge that the Subcontractor has been found in violation of the regulations in [24 CFR](#) § 75.
- 18.6.** The Contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the Contractor is selected but before the Contract is executed, and (2) with persons other than those to whom the regulations of [24 CFR](#) § 75 require employment opportunities to be directed, were not filled to circumvent the Contractor's obligations under [24 CFR](#) § 75.
- 18.7.** Noncompliance with HUD's regulations in [24 CFR](#) § 75 may result in sanctions, termination of this Contract for default, and debarment or suspension from future HUD assisted contracts.
- 18.8. Section 3 Reporting Requirements**
- 18.8.1.** Monthly Section 3 Compliance Reports are required and are to be submitted to the Economic Inclusion Coordinator.
- 18.8.2.** These reports should include a listing of the Contractor's current local workforce, any new hiring or subcontracting that has occurred, along with total labor hours and section 3 worker labor hours on all new hires and all subcontractors permanent employees working on the project.
- 18.9.** The Contractor shall cooperate fully with requests for additional Section 3 information and documentation as needed by CMHA or the Contracting Authority.

19. ARTICLE XIX LABOR STANDARDS**19.1. Compliance with [Davis Bacon and Related Acts](#) requirements**

19.1.1. All rulings and interpretations of the [Davis Bacon and Related Acts](#) contained in 29 CFR are herein incorporated by reference in this Contract.

19.2. Minimum Wages

19.2.1. All laborers and mechanics employed under this Contract in the development or construction of the project(s) involved will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act, the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

- A.** Contributions made or costs reasonably anticipated for bona fide fringe benefits under the [Davis-Bacon Act](#) on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of [29 CFR](#); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the regular weekly period, are deemed to be constructively made or incurred during such weekly period.
- B.** Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in [29 CFR](#).
- C.** Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed.
- D.** The wage determination (including any additional classification and wage rates conformed under [29 CFR](#) and the [Davis-Bacon poster \(WH-1321\)](#) shall be posted at all times by the Contractor and its Subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

19.2.2. Any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination.

- A.** HUD shall approve any additional classification and wage rate and fringe benefits therefor only when all the following criteria have been met:
 - i.** The work to be performed by the classification requested is not performed by a classification in the wage determination;
 - ii.** The classification is utilized in the area by the construction industry; and
 - iii.** The proposed wage rate, including bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.
- B.** If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and HUD or its designee agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by HUD or its designee to the Administrator of the Wage and Hour Division, Employee Standards Administration, U.S. Department of Labor, Washington, DC 20210.
 - i.** The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within thirty (30) calendar days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary.
- C.** In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and HUD or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), HUD or its designee shall refer the questions, including the views of all interested parties and the recommendation of HUD or its designee, to the Administrator of the Wage and Hour Division for determination.

- i. The Administrator or an authorized representative, should issue a determination within thirty (30) calendar days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time was necessary.
- D. The wage rate (including fringe benefits where appropriate) shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in classification.

19.2.3. Whenever the minimum wage rate prescribed in the Contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

19.2.4. If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; provided that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the [Davis-Bacon Act](#) have been met.

- A. The Secretary of Labor may require the Contractor to set aside in a separate account, assets for the meeting of obligations under the plan or program.

19.3. Withholding of Funds

19.3.1. HUD or its designee shall, upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this Contract or any other Federal contract with the same prime Contractor, or any other Federally-assisted contract subject to [Davis-Bacon prevailing wage](#) requirements, which is held by the same prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the Contract.

- A. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working in the construction or development of the Project, all or part of the wages required by the contract, HUD or its designee may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.
- B. HUD or its designee may, after written notice to the Contractor or Subcontractor, issue payment to the respective employees to whom they are due.

19.4. Payrolls and Basic Records

19.4.1. Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working in the construction or development of the Project.

- A. Such records shall contain:
 - i. The name, address, and social security number of each such worker;
 - ii. His or her correct classification
 - iii. Hourly rates of wages paid
 - (a) Including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in the [Davis-Bacon Act](#);
 - iv. Daily and weekly number of hours worked;
 - v. Deductions made; and
 - vi. Actual wages paid.
- B. Whenever the Secretary of Labor has found, under [29 CFR](#), that the wages of any laborer or mechanic include the amount of costs reasonably anticipated in providing benefits under a plan or program described in the [Davis-Bacon Act](#), the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits.

- i. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

19.4.2. The Contractor shall submit for each week in which any contract work is performed a copy of all payrolls to the Contracting Officer for transmission to HUD or its designee.

- A. The payrolls submitted shall set out accurately and completely all of the information required to be maintained.
- B. This information may be submitted in any form desired.
 - i. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
- C. The Contractor is responsible for the submission of copies of payrolls by all Subcontractors (Approved by the Office of Management and Budget under OMB Control Number 1214-0149).
 - i. Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or Subcontractor, or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:
 - (a) That the payroll for the payroll period contains the information required to be maintained and that such information is correct and complete;
 - (b) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or from the full wages earned, other than permissible deductions as set forth in [29 CFR](#); and
 - (c) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated in to the Contract.
 - ii. The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirements for submission of the "Statement of Compliance".
 - iii. The falsification of any of the above certifications may subject the Contractor or Subcontractor to civil or criminal prosecution under Title 18 and Title 31 of the United States Code.

19.4.3. Records

- A. The Contractor or Subcontractor shall make the records available for inspection, copying, or transcription by authorized representatives of HUD or its designee, the Contracting Officer, or the Department of Labor and shall permit such representatives to interview employees during working hours on the job.
- B. If the Contractor or Subcontractor fails to submit the required records or to make them available, HUD or its designee may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds.
- C. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to [29 CFR](#).

19.5. Apprentices & Trainees

19.5.1. Apprentices will be permitted to work at less than predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship and Training, Employer and labor Services (OATELS), or with a State Apprenticeship Agency recognized by OATELS, or if a person is employed in his or her first ninety (90) calendar days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by OATELS or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

- A. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program.

- i. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed.
- ii. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.
- B. Where a Contractor is performing construction on a project in a locality other than that in which registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed.
- C. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination.
 - i. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program.
 - ii. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification.
 - iii. If the Administrator of the Wage and Hour Division determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.
- D. In the event OATELS, or a State Apprenticeship Agency recognized by OATELS, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

19.5.2. Trainees

- A. Except as provided for in [29 CFR](#), trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.
- B. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.
- C. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination.
 - i. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program.
 - ii. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices.
 - iii. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed.
 - iv. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed.
- D. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work until an acceptable program is approved.

19.5.3. Equal Employment Opportunity

- A. The utilization of apprentices, trainees, and journeymen shall be in conformity with the equal employment opportunity requirements of [Executive Order 11246, as amended](#) and [29 CFR](#).

19.6. Compliance with Copeland Act requirements

19.6.1. The requirements of [29 CFR](#), which are hereby incorporated by reference in this Contract

19.7. Contract Termination; Debarment

19.7.1. A breach of ARTICLE XIX LABOR STANDARDS may be grounds for termination of the Contract and for debarment as a Contractor and a subcontractor.

19.8. Disputes Concerning Labor Standards

19.8.1. Disputes arising out of the labor standards provisions of Disputes Concerning Labor Standards shall not be subject to ARTICLE XI DISPUTE RESOLUTION/CLAIM PROCEDURE of this contract.

A. Such disputes shall be resolved in accordance with the procedures of the Department of Labor.

19.8.2. Disputes within the meaning of Disputes Concerning Labor Standards include disputes between the Contractor (or any of its Subcontractors) and CMHA, HUD, the U.S. Department of Labor, or the employees or their representatives.

19.9. Certification of Eligibility

19.9.1. By entering into this Contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded contracts by virtue of the [Davis-Bacon Act](#) or [29 CFR](#).

19.9.2. No part of this Contract shall be subcontracted to any person or firm ineligible for award of a United States Government contract by virtue of the [Davis-Bacon Act](#) or [29 CFR](#).

19.9.3. The penalty for making false statements is prescribed in the U. S. Criminal Code [18 U.S.C.](#)

19.10. Contract Work Hours and Safety Standards Act

19.10.1. As used in 19.10 - Contract Work Hours and Safety Standards Act, the terms "laborers" and "mechanics" include watchmen and guards.

19.10.2. Overtime Requirements

A. No Contractor or Subcontractor contracting for any part of the Contract Work which may require or involve the employment of laborers or mechanics, including watchmen and guards, shall require or permit any such laborer or mechanic in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one half pay for all hours worked in excess of 40 hours in such workweek.

19.10.3. Violation; liability for unpaid wages; Liquidated Damages

A. In the event of any violation, the Contractor and any Subcontractor responsible therefor shall be liable for the unpaid wages.

B. In addition, such Contractor and Subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages.

C. Such liquidated damages shall be computed with respect to each individual laborer or mechanic (including watchmen and guards) employed in violation, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages.

19.10.4. Withholding for unpaid wages and liquidated damages

A. HUD or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of Work performed by the Contractor or Subcontractor under any such Contract or any Federal contract with the same prime Contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or Subcontractor for unpaid wages and liquidated damages.

19.11. Subcontracts

19.11.1. The Contractor or Subcontractor shall insert in any Subcontracts all the provisions contained in Subcontracts, and such other clauses as HUD or its designee may by appropriate instructions require, and also a clause requiring the Subcontractors to include these provisions in any lower tier Subcontracts.

19.11.2. The prime Contractor shall be responsible for the compliance by any Subcontractor or lower tier Subcontractor with all these provisions.

19.12. Non-Federal Prevailing Wage Rates

19.12.1. Any prevailing wage rate (including basic hourly rate and any fringe benefits), determined under State or tribal law to be prevailing, with respect to any employee in any trade or position employed under the Contract, is inapplicable to the Contract and shall not be enforced against the Contractor or any Subcontractor, with respect to employees engaged under the contract whenever such non-Federal prevailing wage rate exceeds:

- A.** The applicable wage rate determined by the Secretary of Labor pursuant to the [Davis-Bacon Act \(40 U.S.C.\)](#) to be prevailing in the locality with respect to such trade;
- B.** An applicable apprentice wage rate based thereon specified in an apprenticeship program registered with the U.S. Department of Labor (DOL) or a DOL- recognized State Apprenticeship Agency; or
- C.** An applicable trainee wage rate based thereon specified in a DOL-certified trainee program.

20. ARTICLE XX HEALTH, SAFETY AND ACCIDENT PREVENTION**20.1. General Contractor Requirements**

20.1.1. In performing this Contract, the Contractor shall:

- A. Take reasonable precautions to ensure safety of individuals on the Project;
- B. Ensure that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his/her health and/or safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation;
- C. Protect the lives, health, and safety of other persons;
- D. Prevent damage to property, materials, supplies, and equipment; and
- E. Avoid work interruptions.

20.1.2. For these purposes, the Contractor shall:

- A. Comply with regulations and standards issued by the Secretary of Labor.
 - i. Failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act; and
- B. Include the terms of ARTICLE XX HEALTH, SAFETY AND ACCIDENT PREVENTION in every Subcontract that such terms will be binding on each Subcontractor.
- C. The Contractor shall be responsible for its Subcontractors' compliance with the provisions of ARTICLE XX HEALTH, SAFETY AND ACCIDENT PREVENTION.
 - i. The Contractor shall take such action with respect to any Subcontract as CMHA, the Secretary of Housing or Secretary of Labor shall direct as a means of enforcing such provisions.
- D. The Contractor shall maintain an accurate record of exposure data on all accidents incident to work performed under this Contract resulting in death, traumatic injury, occupational diseases or damages to property, materials, supplies, or equipment, and shall report this data in the manner prescribed by [29 CFR](#);
- E. The Contractor shall pay any fine or cost incurred because of Contractor's violation, or alleged violation, of any Applicable Law.

20.2. Notification of Non-Compliance Procedure

20.2.1. To the extent CMHA is aware of Contractor's noncompliance with the safety requirements in the Contract, CMHA shall notify the Contractor of any noncompliance with these requirements and of the corrective action required. However, CMHA's failure to notify Contractor of noncompliance with any applicable safety requirements, does not relieve Contractor of any obligation to comply with safety requirements for the Project.

- A. This notice, when delivered to the Contractor or the Contractor's representative at the site of the work, shall be deemed sufficient notice of the noncompliance and corrective action required.

20.2.2. After receiving the notice, the Contractor shall immediately take corrective action.

20.2.3. If the Contractor fails or refuses to take corrective action promptly, CMHA may issue an order stopping all or part of the work until satisfactory corrective action has been taken.

20.2.4. The Contractor shall not base any claim or request for equitable adjustment for additional time or money on any stop order issued under Section 20.2.

20.3. Safety Plan

20.3.1. The Contractor is responsible for designing and implementing its own site-specific safety plan, including compliance with OSHA regulations and such plan shall meet or exceed CMHA's site-specific safety plan (if any).

20.3.2. Before starting any Work, the Contractor shall submit to CMHA a copy of the Contractor's site-specific safety plan and safety manuals.

20.4. Safety Data Sheets

20.4.1. The Contractor shall identify any material it uses at the Site with a Safety Data Sheet ("SDS") meeting the requirements of OSHA's Hazardous Communication Standard.

20.4.2. The Contractor shall maintain a notebook containing all of its applicable SDSs.

- A. This notebook shall be kept at the Site for the duration of the Project.

20.5. Hazardous Materials**20.5.1. Prohibition Against Hazardous Materials**

- A. The Contractor shall not introduce Hazardous Materials to the Project

20.5.2. Work Stoppage Due to Hazardous Materials

- A. If the Contractor encounters material the Contractor reasonably believes to be, or contain, a Hazardous Material that has not been rendered harmless, the Contractor shall immediately stop Work in the affected area and verbally report the condition to CMHA, and within one (1) business day deliver written notice of the condition to CMHA.
- B. CMHA will promptly determine the necessity of CMHA retaining a qualified environmental consultant to evaluate the suspected Hazardous Material and to issue a related written report.
- i. Where appropriate, CMHA will engage a licensed abatement contractor to remove the material or render it harmless as directed.
- C. The Contractor shall resume Work in the affected area upon written notice from CMHA that:
- i. The suspect material was evaluated and found not to be or contain a Hazardous Material; or
- ii. The suspect material has been removed or rendered harmless.
- D. If the Contractor knowingly or negligently proceeds with the Work in an area where a Hazardous Material exists and has not been rendered harmless, the Contractor shall be solely responsible for all related claims, damages, losses, and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from performing the Work in the affected area. Further, to the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA, from and against all claims, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, associated with Contractor knowingly or negligently proceeds with the Work in an area where a Hazardous Material exists and has not been rendered harmless.
- E. The term "rendered harmless" means that the level of exposure is less than any applicable exposure standards set forth in Applicable Law.

20.6. Fires or Hot-Work**20.6.1. Contractor shall not burn any fires on the Site(s).**

- A. The Contractor shall notify the Project Manager twenty-four (24) hours before the start of non-routine or non-recurring hot-work.
- i. Use of sources of fire, flame or sparks and flammable materials shall be kept to an absolute minimum.
- ii. At the beginning of the Project, the Contractor shall inform the Project Manager of its intent to use blowtorches, welding apparatus or similar exposed flame and sparking devices.
- iii. Similar notice shall be given in regard to the use of flammable liquids, adhesives, and cleaners.
- B. The Contractor shall furnish an appropriate number of fire extinguishers (minimum of 1), which shall be within the immediate areas where work is being done at all times.
- i. The extinguisher shall be adequate and suitable for the class of fire likely to be caused by the Contractor's operations.

20.7. Explosives and Blasting**20.7.1. The Contractor shall not conduct blasting on, or bring explosives to the Work Site without written approval of CMHA and other authorities with jurisdiction.****20.7.2. The Contractor shall perform all blasting, storing, and handling of explosives as required under Applicable Law.****20.7.3. The Contractor shall carry appropriate liability insurance coverage, as required by the Contract Documents, for its blasting and explosives storage and handling operations.**

- A. Immediately upon request, the Contractor shall deliver evidence of that insurance to CMHA.

21. ARTICLE XXI CONTRACT DOCUMENTS AND CONTRACT RECORDS**21.1. Examination and Retention of Contractor's Records**

- 21.1.1.** CMHA, HUD, or the Comptroller of the United States, or any of their duly authorized representatives shall, until three (3) years after final payment under this Contract, have access to and the right to examine any of the Contractor's directly pertinent books, documents, papers, or other records involving transactions related to this Contract for the purpose of making audit, examination, excerpts, and transcriptions.
- 21.1.2.** The Contractor agrees to include in first-tier Subcontracts under this Contract a clause substantially the same as 21.1.1.
- A.** "Subcontract," as used in Examination and Retention of Contractor's Records, excludes purchase orders not exceeding \$10,000.
- 21.1.3.** The periods of access and examination for records relating to (1) appeals under ARTICLE XI DISPUTE RESOLUTION/CLAIM PROCEDURE of this contract, (2) litigation or settlement of claims arising from the performance of this Contract, or (3) costs and expenses of this Contract to which CMHA, HUD, or Comptroller General or any of their duly authorized representatives has taken exception shall continue until disposition of such appeals, litigation, claims, or exceptions.
- 21.1.4.** To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA, from and against all claims, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, arising out of or related to any dispute regarding what Person or Persons should be given access to the documents under Section 21.1.
- 21.1.5.** The right of inspection, audit, and reproduction extends to all documents necessary to permit CMHA, or its agents, to perform a complete evaluation of all of the Contractor's costs related to the Project, including, but not limited to, the cost of pricing data submitted along with the computations and projections used therein.
- 21.1.6.** If the Contract has been terminated, in whole or in part, the records relating to the Work terminated shall be made available to CMHA for a period of six (6) years from the date of termination.

21.2. Examination and Audit of Contractor's Records

- 21.2.1.** CMHA may examine all books, records, documents and other data of the Contractor and its Subcontractors related to the bidding, pricing, or performance of the Work for any purpose, including, but not limited to, evaluating any Contractor Payment Request, Proposal, Modification, or Claim.
- 21.2.2.** The above referenced materials shall be made available at the office of the Contractor or Subcontractor, as applicable, at all reasonable times for inspection, audit, and reproduction until the expiration of six (6) years after the date of Substantial Completion of all Work.
- A.** The Contractor shall maintain, and require its Subcontractors to maintain, complete and accurate business records at its principal place of business.
- i.** If the principal place of business is greater than 50 miles from the Site, the Contractor shall timely make records available, and shall require its Subcontractors to timely make records available, at the office of CMHA upon request for the records.
- B.** To the extent that the Contractor or Subcontractor, as applicable, informs CMHA in writing that any documents provided to CMHA are trade secrets, CMHA shall treat these documents, to the extent permitted by law, as trade secrets of the Contractor or Subcontractor, as applicable.
- i.** To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify, defend and hold harmless CMHA, from and against all claims, costs, losses, and damages, including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, arising out of or related to any dispute regarding what Person or Persons should be given access to the documents under Section 21.2.
- 21.2.3.** The right of inspection, audit, and reproduction extends to all documents necessary to permit adequate evaluation of the cost of pricing data submitted along with the computations and projections used therein.
- 21.2.4.** If the Contract has been terminated, in whole or in part, the records relating to the Work terminated shall be made available to CMHA for a period of six (6) years from the date of termination.

21.2.5. Records that relate to disputes, litigation, or settlement of Claims arising out of the performance of the Work shall be made available until the dispute, litigation or Claims have been finally decided or settled.

21.3. Ownership of Contract Documents

21.3.1. CMHA shall have exclusive ownership of, all proprietary interest in, and the right to full and exclusive possession of all information, materials and documents discovered or produced by Contractor pursuant to the terms of this Contract, including but not limited to reports, memoranda, drawings or letters concerning the research and reporting tasks of this Contract.

21.3.2. For data other than computer software, the Contractor grants to CMHA and others acting on its behalf, a paid-up, nonexclusive, irrevocable, world-wide license in such copyrighted data to reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly by or on behalf of CMHA.

21.3.3. CMHA alone owns the Contractor's Documents and the Contract Documents and every right, title, and interest therein.

21.3.4. The Contractor must execute and deliver and cause its agents and subcontractors to execute and deliver, to CMHA any transfers, assignments, documents or other instruments necessary to vest in CMHA the complete right, title, interest in and ownership of the Contractor's Documents.

21.3.5. The Contractor may retain copies of the Contractor's Documents and the Contract Documents for information, reference, and performance of the Work.

21.3.6. The submission or distribution of the Contractor's Documents or the Contract Documents to meet official regulatory requirements or for similar purposes in connection with the Project is not a waiver of CMHA's reserved rights in the Contractor's Documents.

A. Any unauthorized use of the Contractor's Documents or the Contract Documents shall be at the sole risk of the entity making the unauthorized use.

21.4. Intent of Contract Documents

21.4.1. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of Work by the Contractor.

21.4.2. The Contract Documents are complementary, and what is required by one is binding as if required by all.

21.4.3. The Contractor shall provide all labor materials necessary for the entire completion of the Work described in the Contract Documents and reasonably inferable to produce the intended results.

21.4.4. The Drawings govern dimensions, details, and location of the Work.

A. The Specifications govern the quality of materials and workmanship.

21.4.5. The organization of the Specifications in divisions, sections, and articles, and the arrangement of Drawings shall not restrict the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

21.4.6. Unless otherwise defined in the Contract Documents, words that have well known technical or construction industry meanings are used within those recognized meanings.

21.5. Use of Electronic Files

21.5.1. CMHA and Contractor reasonably expect that they will provide Electronic Files to each other to facilitate the design and construction of the Project consistent with current practices and customs in the construction industry.

21.5.2. CMHA and Contractor acknowledge that the use of Electronic Files involves risks not generally associated with the use of paper documents.

A. Those risks may include, but not be limited to, alteration (inadvertent or intentional) and deterioration, both of which may not be apparent through casual observation.

21.5.3. In the event of a discrepancy between information contained in a paper version of a document and the Electronic File of that document, the paper will govern.

21.5.4. Use of Electronic Files does not relieve the Contractor of its responsibility for the preparation, completeness, or accuracy of the Contractor's Documents.

21.6. Order of Precedence

21.6.1. In the event of any inconsistency or conflict within any of the Contract Documents, the Contractor shall provide the better quality of Work and comply with the stricter requirement.

21.6.2. In the event of a conflict between the contract and any applicable state or local law or regulation, the state or local law or regulation shall prevail; provided that such state or local law or regulation does not conflict with, or is less restrictive than applicable federal law, regulation, or Executive Order.

A. In the event of such a conflict, applicable federal law, regulation, and Executive Order shall prevail.

22. ARTICLE XXII MISCELLANEOUS**22.1. Assignment**

22.1.1. The Contractor shall not assign or transfer any interest in this Contract; except that Claims for monies due or to become due from CMHA under the Contract may be assigned to a bank, trust company, or other financial institution.

- A.** Such assignments of claims shall only be made with the written concurrence of CMHA.
- B.** If the Contractor is a partnership, this contract shall inure to the benefit of the surviving or remaining member(s) of such partnership as approved by CMHA.

22.1.2. Assignment of Antitrust Claims:

- A.** By signing the Agreement, the Contractor assigns, conveys and transfers to CMHA any right, title, and interest to any claims or causes of action it may have or acquire under state or federal antitrust laws relating to any goods, products, or services purchased, procured, or rendered to CMHA pursuant to the Contract.

22.1.3. CMHA and Contractor each bind themselves, their successors, assigns and legal representatives, to the other party to this Contract and to the successors, assigns, and legal representatives of the other party with respect to the Contract.

22.2. Contractor Performance Evaluation

22.2.1. CMHA may evaluate the Contractor's Performance at any time including without limitation during the progress of the Work, at the completion of a phase of the Project, and/or completion of the Project.

22.2.2. CMHA shall retain the evaluation.

- A.** The Contractor may request a copy of the completed evaluation(s).
 - i.** If the Contractor wishes to comment or take exception to any rating or remark, the Contractor must send a response in writing to CMHA within thirty (30) calendar days of Contract Completion and/or Termination.
- B.** CMHA may use the evaluation(s) in determining the responsibility of the Contractor for award of future contracts.
- C.** Poor evaluations may lead to a determination that Contractor is not responsible and therefore ineligible for award of future contracts for a period of not less than one year.
- D.** CMHA may request information from the Contractor for use in evaluating the A/E's performance.
 - i.** If information is requested, the Contractor shall comply in a timely and responsive manner.
- E.** If a breach of the Contract is committed by the Contractor or is attributable to a Subcontractor, that breach will be used in the responsibility analysis of the Contractor and Subcontractor (where applicable) for future contracts or subcontracts for a period of five (5) years after the date of the breach unless said breach results in Contractor being placed on debarment list, then for the period provided therein.

22.3. Prohibition Against Liens

22.3.1. The Contractor is prohibited from placing a lien on CMHA's property.

- A.** This prohibition shall apply to all Subcontractors at any tier and all materials suppliers.

22.4. Conflict of Interest**22.4.1. Interest of Members of Congress**

- A.** No member of or delegate to the Congress of the United States of America shall be admitted to any share or part of this contract or to any benefit that may arise therefrom.

22.4.2. Interest of Members, Officers, or Employees and Former Members, Officers, or Employees

- A.** No member, officer, or employee of CMHA, no member of the governing body of the locality in which the Project is situated, no member of the governing body of the locality in which CMHA was activated, and no other public official of such locality or localities who exercises any functions or responsibilities with respect to the Project, shall, during his or her tenure, or for one year thereafter, have any interest, direct or indirect, in this Contract or the proceeds thereof.

22.5. Limitation on Payments Made to Influence Certain Federal Financial Transactions

22.5.1. The Contractor agrees to comply with Title 31, United States Code which prohibits the use of Federal appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with any of the following covered Federal actions:

- A. The awarding of any Federal contract;
- B. The making of any Federal grant;
- C. The making of any Federal loan;
- D. The entering into of any cooperative agreement; or
- E. The modification of any Federal Contract, grant, loan, or cooperative agreement.

22.5.2. The Contractor further agrees to comply with the requirement of the Act to furnish a disclosure (OMB Standard Form LLL, Disclosure of Lobbying Activities) if any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a Federal contract, grant, loan, or cooperative agreement.

22.6. Procurement of Recovered Materials

22.6.1. In accordance with the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, the Contractor shall procure items designated in guidelines of the Environmental Protection Agency (EPA) [40 CFR](#) that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition.

- A. The Contractor shall procure items designated in the EPA guidelines that contain the highest percentage of recovered materials practicable unless the Contractor determines that such items:
 - i. Are not reasonably available in a reasonable period of time;
 - ii. Fail to meet reasonable performance standards, which shall be determined on the basis of the guidelines of the National Institute of Standards and Technology, if applicable to the item; or
 - iii. Are only available at an unreasonable price.

22.6.2. 22.6.1 shall apply to items purchased under this contract where:

- A. The Contractor purchases in excess of \$10,000 of the item under this contract; or
- B. During the preceding:
 - i. Purchased any amount of the items for use under a contract that was funded with Federal appropriations and was with a Federal agency or a State agency or agency of a political subdivision of a State; and
 - ii. Purchased a total of in excess of \$10,000 of the item both under and outside that contract.

22.7. Royalties and Patents

22.7.1. The Contractor shall pay all royalties and license fees and assume all costs incident to the use, in the performance of the Work or the incorporation in the Work, of any design, inventions, process, product, or devise that is the subject of patent rights or copyrights held by others.

- A. Contractor shall defined all suits or claims for infringement of any patent rights or copyrights and shall save CMHA harmless from loss on account thereof; except that CMHA shall be responsible for all such loss when a particular design, process, or the product of a particular manufacturer or manufacturers is specified and the Contractor has no reason to believe that the specified design, process, or product is an infringements.
- B. If, however, the Contractor has reason to believe that any design, process or product specified is an infringement of a patent or copyright, the Contractor shall promptly notify the Contracting Officer.
 - i. Failure to give such notice shall make the Contractor responsible for resultant loss.

22.8. Contract Time for Substantial Completion

22.8.1. The Contractor shall have the Work Substantially Complete as established in the Notice to Proceed issued by CMHA. If a Notice to Proceed is not issued, the date for commencement of the Work shall be the effective date of the Contract.

22.9. Other Contracts

22.9.1. CMHA may undertake or award other contracts for additional work at or near the site of the Work under this contract.

22.9.2. The Contractor shall fully cooperate with the other contractors and with CMHA employees and shall carefully adapt scheduling and performing the work under this Contract to accommodate the additional work, heeding any direction that may be provided by CMHA.

22.9.3. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor or by CMHA employees.

22.10. Drug-Free Workplace

22.10.1. Each contractor shall be enrolled in and in good standing and shall require all subcontractors with whom the Contractor is in contract for the public improvement to be enrolled in and be in good standing in the Bureau of Workers' Compensation's Drug-Free Workplace Program or a comparable program approved by the Bureau that meets the requirements specified in the Revised Code prior to a subcontractor providing labor at the Project site of the public improvement.

22.11. Energy Efficiency and Sustainability Requirements

22.11.1. The Contractor shall comply with mandatory standards and policies relating to energy efficiency which are contained in the energy conservation plan issued in compliance with the Energy Policy and Conservation Act for the State in which the work under the contract is performed.

22.11.2. If the Project is designed and constructed under the Leadership in Energy and Environmental Design ("LEED") Rating System developed by the U.S. Green Building Council or another rigorous rating system used to facilitate achievement of sustainability goals for the Project, the Contractor shall provide submittals certifying achievement of sustainable designed rating system criteria for verification by the Green Building Certification Institute or other third party in accordance with the Contract Documents.

22.12. Clean Air and Water

22.12.1. The Contractor shall comply with the Clean Air Act, as amended [42 USC](#), the Federal Water Pollution Control Water Act, as amended [33 U.S.C.](#), and standards issued pursuant thereto in the facilities in which this Contract is to be performed.

22.13. Public Relations

22.13.1. Public relations or publicity about the Project shall be solely within the control of and consent of CMHA.

22.13.2. Contractor shall submit to CMHA all advertising and publicity related matter relating to this Contract, including without limitation, information provided in social media, wherein CMHA's name is mentioned or language used from which the connection of CMHA's name may, in CMHA's judgment, be inferred or implied.

A. Contractor shall not publish or use such advertising and publicity matters without prior express written consent of CMHA.

22.14. Governing Law

22.14.1. This Contract shall be governed and construed exclusively by its terms and by the laws of the State of Ohio and any suit filed to enforce any term of this Contract shall be filed only in a court of competent jurisdiction in Hamilton County, Ohio.

22.14.2. The parties to this Contract shall comply with applicable law.

22.15. Written Notice

22.15.1. Notice under the Contract Documents shall be validly given if:

A. Delivered personally to a member of the organization for whom the notice is intended.

22.16. Taxes

22.16.1. Parties acknowledge that CMHA is a tax exempt entity and Contractor must use tax exemption status for all purchases made for the Project in which tax exemption is permitted under law.

22.17. Computing Time

22.17.1. When the Contract Documents refer to a period of time by a number of days, the period shall be computed to exclude the first and include the last day of the period.

A. If the last day of the period falls on a Saturday or Sunday, or a legal holiday, that day shall be omitted from the computation and the period shall end on the next business day.

22.17.2. Except as excluded, the Contract Times and all other periods referred to in the Contract Documents includes Saturdays, Sundays, and all days defined as legal holidays below.

22.17.3. The standard workdays for the Work are Monday through Friday, excluding legal holidays.

22.17.4. The Legal Holidays are as follows:

- A. New Year's Day
- B. Martin Luther King Jr. Day
- C. President's Day
- D. Memorial Day
- E. Independence Day
- F. Labor Day
- G. Columbus Day
- H. Veterans Day
- I. Thanksgiving Day
- J. Christmas Day

22.18. Time is of the Essence**22.18.1.** All time limits set forth in the Contract Documents are of the essence.

- A. By signing this Contract, Contractor acknowledges that the Contract Times are reasonable, taking into consideration the usual weather and other conditions prevailing in the locality of the Project.
- B. By signing the Construction Progress Schedule, the Contractor acknowledges that the specified Milestone dates and the Date for Substantial Completion are reasonable, taking into consideration the usual weather and other conditions prevailing in the locality of the Project.

22.18.2. The Notice to Proceed establishes the date for commencement of the Work.**22.18.3.** The Contractor acknowledges that it may be subject to interference, disruption, hindrance, or delay in the progress of the Work from any cause.

- A. The sole remedy for such interference, disruption, hindrance, or delay shall be an extension of the Contract Time MODIFICATIONS, unless otherwise required by law.

22.19. Extent of Contract**22.19.1.** The Contract Documents represent the entire and integrated agreement between CMHA and the Contractor and supersede all prior negotiations, representations, or agreement, either written or oral.**22.19.2.** This Contract may be executed in any number of counterparts, each of which shall be regarded as original and all of which constitute but one and the same instrument.**22.19.3.** The captions and headings in this Contract are for convenience only and in no way define, limit, or describe the scope or intent of any of the provisions or sections hereof.**22.20. Severability****22.20.1.** If any provision of this Contract is determined by a court having jurisdiction to be unenforceable to any extent, the rest of the provisions of this Contract will remain enforceable to the fullest extent permitted by law.**22.21. Facsimile/Electronic Mail Signature****22.21.1.** Any party hereto may deliver a copy of its counterpart signature page of any Contract Documents via email, fax, or web-based project management software.**22.21.2.** Each party shall be entitled to rely upon a scanned or facsimile signature of the other party in such a manner as if such a signature were an original.**22.22. No Third Party Interest****22.22.1.** Except as expressly provided herein, no person or entity, other than CMHA and Contractor, will have any right or interest under the Contract, and the Contract does not create a contractual relationship of any kind between any persons or entities other than CMHA and the Contractor.**22.23. No Waiver****22.23.1.** The failure of CMHA or Contractor to insist on anyone or more instances upon strict performance of any one or more of the provisions of the Contract or to exercise any rights under the Contract or provided by law will not be construed as a waiver or relinquishment of that provision or of the right to subsequently demand strict performance or exercise the right and the rights will continue unchanged and remain in full force and effect.**22.24. Assignment of Antitrust Claims**

22.24.1. By signing this Contract, the Contractor conveys, assigns and transfers to CMHA any right, title, and interest in any claims or causes of action it may have or acquire under state or federal antitrust laws relating to any goods, products, or services purchased, procured, or rendered to CMHA pursuant to this Contract.

22.25. Survival of Obligations

22.25.1. All representations, indemnity obligations, warranties, guarantees, and other expressed continuing obligations under the Contract, will survive final payment, completion and acceptance of the Work, and termination or completion of the Contract.

22.26. Force Majeure

22.26.1. Neither party shall be liable for failure to perform if such failure is caused by conditions beyond its control including, but not limited to, Acts of God, Government restrictions (including the denial or cancellation of any export or other necessary license), wars, and/or insurrections.

22.27. Privacy

22.27.1. The Contractor agrees to Comply with the [Privacy Act of 1974](#) (the Act) and the agency rules and regulations issued under the Act and any Personal information collected, used, or acquired in connection with this Contract shall be protected against unauthorized use, disclosure, modification or loss.

22.27.2. Contractor shall ensure that its directors, officers, employees, subcontractors or agents use personal information solely for the purposes of accomplishing the services set forth herein.

22.27.3. Contractor agrees not to release, divulge, publish, transfer, sell or otherwise make known to unauthorized persons personal information without express written consent of CMHA or otherwise required by law.

22.27.4. Contractor agrees to indemnify and hold harmless CMHA for any damages related to Contractor's unauthorized use of personal information.

22.28. Contractor Status

22.28.1. It is understood that the Contractor is an independent contractor and is not to be considered an employee of CMHA, or assume any right, privilege or duties of an employee.

23. ARTICLE XXIII DEFINITIONS AND TERMINOLOGY

23.1. Whenever used in the Contract Documents, the terms listed below will have the meanings meaning ascribed which are applicable to both the singular and the plural and the male and female gender thereof:

23.1.1. Abandonment

- A. A willful decision by the Contractor suspending the progress of the work for an uninterrupted period of three (3) or more consecutive days (excluding weekends and holidays) and such suspension was not requested by CMHA and not caused by natural occurrences or acts of God.

23.1.2. Acceptable Component

- A. A component listed in the Specifications after the Basis of Design Component.

23.1.3. Addenda

- A. Written or graphic instruments issued prior to the opening of Bids that clarify, correct, or change the Bidding requirements or the Contract Documents.

23.1.4. Agreement

- A. The form provided by CMHA, including all of its exhibits, that, when completed and signed by the Contractor and CMHA is evidence of the execution of the Contract.

23.1.5. Allowance

- A. An amount budgeted for during the Bidding process for an item that has yet to be specified or defined and for which no exact dollar amount is available.

23.1.6. Alternate

- A. A change in the proposed Project scope, which may include alternate materials or methods of construction and an amount stated on the Bid form to be added or deducted from the Base-Bid if the corresponding Alternate is incorporated into the Contract.

23.1.7. Applicable Law

- A. All federal, state, and local codes, statutes, ordinances, and regulations that apply to the performance of the Work.

23.1.8. Architect/Engineer (A/E)

- A. The person or other entity engaged by the CMHA to perform architectural, engineering, design, and other services related to the work as provided for in the Contract.
- B. When CMHA uses an engineer to act in this capacity, the terms “architect” and “engineer” shall be synonymous.

23.1.9. Asbestos

- A. Any material that contains more than one percent (1%) asbestos fiber and is friable or is releasing asbestos fibers into the air above current action levels established by OSHA

23.1.10. As-Built Documents

- A. Drawings, addenda, Specifications, executed Change Orders and other elements of the Contract Documents which the Contractor annotates and otherwise modified to indicate changes made during the construction process, the location of concealed and buried items, and other information useful to CMHA throughout the life of the completed Project.

23.1.11. Base-Bid

- A. The amount stated in a Bid as the sum for which the Bidder offers to perform the Work in a particular trade or other category, which is described in the Contract Documents, excluding Alternates.

23.1.12. Basis of Design

- A. A document that records the concepts, calculations, decisions, and product selections used to meet CMHA’s Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines.
- B. The document includes both narrative descriptions and lists of individual items that support the design process.

23.1.13. Basis of Design Component

- A. A component listed first in the Specifications.

23.1.14. Bid

- A. The written offer of a Bidder submitted on the prescribed CMHA Bid Form setting forth the prices for the Work to be performed.

23.1.15. Bidder

- A. The person that submits a Bid.

23.1.16. Bid Form

- A. A form furnished by CMHA with the proposed Contract Documents that is to be completed, signed, and submitted containing the Bidder's Bid.

23.1.17. Bid Guaranty

- A. A bid bond or other instrument of security authorized by [24 CFR](#) submitted with the Bid to provide assurance that the Bidder will execute the Agreement.

23.1.18. Bond

- A. Bid, performance and payment bonds and other instruments of security submitted by the Contractor to assure that the Contractor will perform the Work of the Contract, including making payment to Subcontractors and Material Suppliers.

23.1.19. Building Information Model (BIM)

- A. A digital representation of physical and functional characteristics of a facility and a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition.
 - i. It describes the process of designing a building collaboratively using one coherent system of computer models rather than as separate sets of drawings.

23.1.20. Building Permit

- A. The term building permit as used in the Contract Documents shall mean any and all permits required to comply with local and state building codes.

23.1.21. Certificate of Completion or Certificate of Contract Completion

- A. A form, issued by CMHA, that documents the Contractors achievement of Contract Completion.

23.1.22. Certificate of Substantial Completion

- A. A form, issued by CMHA, which is used to document:
 - i. That the Contractor has achieved Substantial Completion of the Work or a designated portion of the Work; and
 - ii. The date on which the associated Substantial Completion of the Work was achieved.

23.1.23. Change Order

- A. A document recommended by the A/E and executed by CMHA and the Contractor that modifies the Contract and authorizes an addition, deletion, or revision in the work and an adjustment in the Contract Sum or the Contract Time or both.

23.1.24. Change Order Request

- A. A CMHA prescribed form issued after execution of the Contract requesting a Change Order from the Contractor(s), which may initiate a Change Order to modify the Contract.

23.1.25. Claim

- A. A demand or assertion, initiated by written notice as prescribe in the Contract Documents, by the Contractor or CMHA seeking an adjustment of Contract Sum or Contract Time or both, or other relief with respect to the terms of the Contract.

23.1.26. Claim Affidavit

- A. A sworn document used in conjunction with filing a lien, which contains a claim on the funds that are due to a Contractor, in favor of a person supplying labor, materials or services for the value of labor, materials, or services supplied.

23.1.27. Construction

- A. The term used to include new construction, reconstruction, renovation, restoration, rehabilitation, major repair, demolition and all similar work upon buildings and ancillary facilities, including any draining, dredging, grading or similar work upon real property.

23.1.28. Construction Progress Schedule

- A. The critical path schedule for performance of the Contract; showing the time for completing the Work within the Contract Times; the planned sequence for performing the various components of the Work; the interrelationship between the activities of the Contractor, A/E, and CMHA; and the Contractor's resource and cost loading information; as periodically updated during the performance of the Work.

23.1.29. Contract

- A. The contract entered into between the Contractor and CMHA.
- B. It includes:
 - i. The Bid;
 - ii. The Bid Bond;
 - iii. The Performance and Payment Bond or Bonds or other assurance of completion;
 - iv. The Certifications, Representations, and Other Statements of Bidders;
 - v. The HUD General Conditions of the Contract for Construction;
 - vi. The CMHA Construction Contract General Terms and Conditions;
 - vii. The applicable wage rate determinations from the U.S. Department of Labor;
 - viii. Any special conditions included elsewhere in the contract;
 - ix. The specifications; and
 - x. Drawings
- C. It includes all formal changes to any of those documents by addenda, Change Order or modification.

23.1.30. Contract Documents

- A. Collectively, the documents that constitute the substance of the Contract including, but not limited to:
 - i. The Bid;
 - ii. The Bid Bond;
 - iii. The Performance and Payment Bond or Bonds or other assurance of completion;
 - iv. The Certifications, Representations, and Other Statements of Bidders;
 - v. The HUD General Conditions of the Contract for Construction;
 - vi. The CMHA Construction Contract General Terms and Conditions;
 - vii. The applicable wage rate determinations from the U.S. Department of Labor;
 - viii. Any special conditions included elsewhere in the contract;
 - ix. The specifications; and
 - x. Drawings
- B. It includes all formal changes to any of those documents by addenda, Change Order or modification.

23.1.31. Contract Commencement Date

- A. The date established in the Notice to Proceed issued by CMHA to the Contractor to mark the start of the Work and the beginning of the running of the Contract Time. If a Notice to Proceed is not issued, the Contract Commencement Date shall be the effective date of the Contract.

23.1.32. Contract Completion Date

- A. The date by which the Work must be finally complete
- B. The Contract Completion Date is established in Section 9.8 herein.

23.1.33. Contract Sum

- A. The Contractor's entire compensation for the Contractor's proper, timely, and complete performance of the Work and is subject to adjustment as provided in the Contract.

23.1.34. Contract Time

- A. The periods stipulated in the Agreement for the achievement of associated Milestones and Substantial Completion, in consecutive days, beginning on the date established by the Notice to Proceed, including adjustments authorized by executed Change Orders.

23.1.35. Contractor

- A. The person or other entity entering into the Contract with CMHA to perform all of the work required under the Contract.

23.1.36. Contractor Payment Application Request

- A. The form furnished by CMHA that is to be used by the Contractor in requesting payments and which, when signed by the Contractor, shall serve as an affidavit that payments requested are in proportion to the Work completed as shown on the Schedule of Values.

23.1.37. Contractor's Documents

- A. All Project-related documents, including those in electronic form, prepared by the Contractor and its Subcontractors.

23.1.38. Contractor's Fee

- A. The portion of the Contract Sum attributable to the aggregate of the Contractor's profit and home-office overhead related to the Contractor's proper, timely, and complete performance of the Work.

23.1.39. Contractor's Punch List

- A. A document prepared by the Contractor that consists of a list of items of Work to be completed or corrected by the Contractor as a condition precedent to Contract Completion.

23.1.40. Coordination Drawings

- A. Drawings and Electronic Files prepared by the Contractor to demonstrate how multiple-system and interdisciplinary work will be coordinated.
- B. Clash reports generated by BIM authoring software may be included in the Coordination Drawing submittals if applicable.

23.1.41. Correction Period

- A. A period of one-year commencing on the date of Substantial Completion of the Work or a designated portion of the Work which CMHA has agreed to take Partial Occupancy.

23.1.42. Day

- A. A calendar day of twenty-four (24) hours measured from midnight to midnight, unless otherwise expressly specified to mean a business day.

23.1.43. Defective Work

- A. Work that:
 - i. Does not conform to the Contract Documents;
 - ii. Does not meet the requirements of any applicable statute, rule or regulation, inspection, reference standard, test or approval;
 - iii. Has been damaged prior to the A/E's recommendation of final payment, unless responsibility for the protection thereof has been expressly assumed by CMHA; or
 - iv. That is not free from defects in workmanship, materials or equipment during the period of any warranty or guarantee

23.1.44. Differing Site Condition

- A. Subsurface or latent physical conditions at the site which differ materially from those indicated in this Contract; or
- B. Unknown physical conditions at the site(s), of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the Contract Documents.

23.1.45. Drawings

- A. The drawings enumerated in the schedule of drawings contained in the Specifications and as described in the Contract Documents; and
- B. Graphic portions of the Contract Documents, showing the design, type of construction, location, dimension, and character of the Work to be provided by the Contractor, which generally includes plans, elevations, sections, details, schedules, diagrams, notes, and text.

23.1.46. Electronic File

- A. Information maintained in a computer system or format that is intended to facilitate a Person's use and manipulation of the information including but not limited to Word, Excel, PDF, Primavera, CAD, and BIM files all in their native format.

23.1.47. Enclosure, Permanent

- A. The condition in which the permanent exterior walls and roofs are in place, insulated, weatherproof and weather-tight, and permanent windows and entrances are in place

23.1.48. Enclosure, Temporary

- A. The condition in which the permanent exterior walls and roofs are in place, insulated, weatherproof and weather-tight, and windows and entrances are provided with suitable temporary enclosures

23.1.49. Estimated Construction Cost

- A. The sum of the Estimated Contract Cost amounts published in the Solicitation, as modified by Addenda, for a phase of the Project.

23.1.50. Estimated Contract Cost

- A. The estimated amount for the Contract published in the Solicitation, including the Base Bid estimate and the estimates of selected Alternates, if any, as modified by Addenda.

23.1.51. Extra Materials

- A. Materials required by the Contract Documents that are not incorporated into the Project but are given to CMHA to be used for future maintenance or repairs.

23.1.52. Final Inspection

- A. The final review of the Work of the Contractor by the A/E and CMHA to determine whether issuance of the Certificate of Contract Completion will be issued by CMHA.

23.1.53. Frivolous RFI

- A. RFI's that request information that is evident in the Contract Documents and/or RFI's that do not comply with the definition of an RFI as indicated below.

23.1.54. General Conditions

- A. CMHA's General Conditions currently in effect, which may be modified by the CMHA from time to time.

23.1.55. General Conditions Costs

- A. General Conditions Costs include only the Contractor's costs to provide the general conditions Work including without limitation the costs of all of the following Site related items:
 - i. Scheduling and coordinating the Work;
 - ii. Telephone;
 - iii. Telephone charges;
 - iv. Facsimile;
 - v. Telegrams;
 - vi. Postage
 - vii. Photos
 - viii. Photocopying;
 - ix. Hand tools;
 - x. Simple scaffolds (one level high);
 - xi. Tool breakage;
 - xii. Tool repairs;
 - xiii. Tool replacement;
 - xiv. Tool blades;
 - xv. Tool bits; and
 - xvi. Pre-approved travel, lodging, and parking costs
- B. General Conditions Costs also include:
 - i. Bond premiums; and
 - ii. Premiums for Builder's Risk insurance, if the Contractor is required to purchase Builder's Risk insurance policy for the Project.

23.1.56. Hazardous Materials

- A. Any material, substance, pollutant, or contaminant that is defined, regulated, referenced, or classified in the Comprehensive Environmental Response, Compensation and Liability Act, Federal Water Pollution Control Act, the Resource Conservation and Recovery Act, Clean Air Act, Hazardous Materials Transportation Uniform Safety Act, Toxic Substances Control Act, or any other Applicable Law relating to any hazardous, toxic, or dangerous waste, substance, or material.
- B. Any substance or material that, after release into the environment or upon exposure, ingestion, inhalation, or assimilation, either directly from the environment or directly by ingestion through food chains, will, or may reasonably be anticipated to, cause death, disease, behavior abnormalities, cancer or genetic abnormalities and specifically includes but is not limited to asbestos, polychlorinated biphenyls ("PCBs"), radioactive materials, including radon and naturally occurring radio nuclides, natural gas, natural gas liquids, liquefied natural gas, synthetic gas, oil, petroleum and petroleum-based derivatives and urea formaldehyde.

23.1.57. HUD

- A. The United States of America acting through the Department of Housing and Urban Development including the Secretary, or any other person designated to act on its behalf.
- B. HUD has agreed, subject to the provisions of an Annual Contributions Contract (ACC), to provide financial assistance to CMHA, which includes assistance in financing the work to be performed under this Contract.
- C. As defined elsewhere in Contract Documents, the determination of HUD may be required to authorize changes in the work or for release of funds to CMHA for payment to the Contractor.
- D. Notwithstanding HUD's role, nothing in this Contract shall be construed to create any contractual relationship between Contractor and HUD.

23.1.58. Indemnified Parties

- A. CMHA, the A/E, other Separate Consultants, and their respective officials, officers, consultants, agents, representatives, and employees, in both individual and official capacities.

23.1.59. Install

- A. Put into use or place in final position, complete and ready for intended service or use.

23.1.60. Liquidated Damages

- A. A sum established in the Contract Documents, pursuant to the statutory delay forfeiture authorized under ORC and federal regulations, to be paid to CMHA due to the Contractor's failure to complete the Work within the Contract Time for achievement of Substantial Completion, or any applicable portion of the Work on or prior to any Milestone date stated on the Contract Documents.

23.1.61. Material Supplier

- A. A Person under a contract with the Contractor to furnish materials or supplies in furtherance of the Work, including all such Persons in any tier.
- B. Material Supplier does not include any Separate Contractor unless expressly assigned in writing to the Contractor by CMHA and accepted by the Contractor.

23.1.62. Milestone

- A. A principal event specified in the Contract relating to an intermediate completion date or time prior to Substantial Completion of all Work.

23.1.63. Modification

- A. A written amendment to the Contract signed by both parties;
- B. A Change Order;
- C. A Change Directive; or
- D. An order for a minor change in the Work.

23.1.64. Notice of Commencement

- A. A notice prepared by CMHA identifying the Project, the Contractors, the Surety for each Contractor, and the name CMHA's representative upon whom a Claim Affidavit may be served.

23.1.65. Notice of Intent to Award

- A. A written notice provided by CMHA to the apparent successful Bidder stating that upon satisfactory compliance with all conditions precedent for execution of a Contract within the time specified CMHA intends to execute a Contract with the Bidder.

23.1.66. Notice to Proceed

- A. A written notice provided by CMHA authorizing the Contractor to proceed with the Work and establishing the date(s) for commencement and completion of the Work.

23.1.67. ORC

- A. The Ohio Revised Code.

23.1.68. Owner

- A. The Cincinnati Metropolitan Housing Authority or its instrumentality or affiliate for whom the Project is being constructed.

23.1.69. Owner's Project Requirements

- A. A written document that details the functional requirements of the Project and the expectations of how it will be used and operated
- B. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

23.1.70. Partial Occupancy

- A. The condition that occurs when CMHA occupies or uses a portion of the Project prior to Contract Completion, partial occupancy is approved by authorities having jurisdiction, and items of Work cannot be completed until a subsequent date.

23.1.71. Person

- A. An individual, corporation, business trust, estate, partnership, association, or other public or private entity.

23.1.72. Phase

- A. A separation in the Work of the Project by sequence or time intervals, which may include separate contractors for each Phase.

23.1.73. Plan Holder

- A. A prospective Bidder that received a set of Contract Documents prior to the bid opening.

23.1.74. Product Data

- A. Manufacturer's standard illustrations, schedules, diagrams, performance charts, instructions, and brochures that illustrate physical appearance, size, and other characteristics of materials and equipment.

23.1.75. PHA

- A. A Public Housing Authority which at all times shall mean the Cincinnati Metropolitan Housing Authority unless otherwise specified in the Contract Documents.

23.1.76. Project

- A. The entire project, whether construction or rehabilitation, the work for which is provided for in whole or in part under the Contract Documents.

23.1.77. Project Manager

- A. An employee of CMHA assigned to the Project and authorized to perform specific responsibilities.
- B. A Project Manager may also be referred to as a Construction Manager or Construction Contract Administrator.

23.1.78. Project Record Documents

- A. Electronic files and printed documents of all nature prepared by the A/E, which incorporate the information shown on the Contractor's As-Built Documents.
- B. They consist of:
 - i. The "Record Drawings";
 - ii. Certificate of Substantial Completion;
 - iii. Certificate of Contract Completion (as complete);
 - iv. Contractor's Warranty;
 - v. Manufacturers' Warranties, certificate(s) of occupancy, approved shop drawings and other action submittals;
 - vi. Proposal Requests;
 - vii. Requests for Interpretation;
 - viii. Addenda;
 - ix. Change Orders;
 - x. Balancing Reports; and
 - xi. The final version of the approved Construction Progress Schedule

23.1.79. Proposal

- A. The offer of a Contractor to perform the Work set forth in a Proposal Request.

23.1.80. Provide

- A. Furnish and install, complete and ready for intended use.

23.1.81. Punch List

- A. A document listing items of Work requiring correction or completion by the Contractor as a condition precedent to Contract Completion.

23.1.82. Record Drawings

- A. Synonymous to As-Built Drawings; and,

- B. The Drawings, which have been revised by the A/E to show the changes made during the construction process, conformed to represent the Work as executed by the Contractor.

23.1.83. Request for Interpretation/Information (RFI)

- A. A written request to CMHA or the A/E seeking an interpretation or clarification of the Contract Documents.

23.1.84. Samples

- A. Physical examples, color selection items, field samples, and mock-ups furnished by the Contractor to illustrate functional and aesthetic characteristics of products, materials, equipment, or workmanship and establish criteria by which the Work shall be judged.

23.1.85. Schedule of Values

- A. A full, accurate, and detailed statement furnished by the Contractor reflecting a defined breakdown of the Contract Sum.

23.1.86. Separate Consultant

- A. A Person engaged by CMHA to provide Project-related professional services other than the services under this Contract.
- B. The term includes the Separate Consultant's authorized representatives, successors, assigns, and sub-consultants regardless of tier.

23.1.87. Separate Contract

- A. The contract between CMHA and a Separate Consultant or a Separate Contractor.

23.1.88. Separate Contractor

- A. A Person under contract CMHA to provide Project related work other than the Work under this Contract.
- B. The term includes the Separate Contractor's authorized representatives, successors, assigns, and subcontractors regardless of tier.

23.1.89. Shop Drawings

- A. Drawings, diagrams, illustrations, and schedules specifically prepared for the Project provided by the Contractor or a Subcontractor to illustrate some portion of the Work.
- B. Shop Drawings are not Contract Documents.
- C. Shop Drawings on equipment shall include a written statement from the manufacturer of the equipment certifying the equipment is in compliance with the Contract Documents.

23.1.90. Site

- A. The location designated for the Project.

23.1.91. Specifications

- A. The written description of the technical requirements for construction and includes the criteria and tests for determining whether the requirements are met.

23.1.92. Stage

- A. A distinct period in the life cycle of a facility from concept through construction, to use and deconstruction or demolition.
- B. Typical Stages include Program Verification, Schematic Design, Design Development, Construction Documents, Bidding and Award stages; and the Construction, which includes Construction and Closeout activities.

23.1.93. Subcontract

- A. Any contract or agreement between the Contractor and a Subcontractor for performance of a portion of the Work.

23.1.94. Subcontract Form

- A. The Subcontract Form prescribed CMHA and required for use by Contractor when engaging Subcontractors.

23.1.95. Subcontractor

- A. A Person who undertakes to perform any part of the Work on the Project under a contract with a Contractor or with any Person other than the State, including all such Persons in any tier.
- B. The term "Subcontractor" includes Material Suppliers, but does not include any Separate Contractor unless expressly assigned in writing to the Contractor by CMHA and accepted by the Contractor.

23.1.96. Supplementary Conditions

- A. Amendments to the CMHA Construction Contract General Terms and Conditions, issued as a separate document, prescribed by CMHA, which describes conditions of the Contract unique to a particular Project, which may include:
 - i. Provisions regarding the assignment of responsibility for refuse removal;
 - ii. Safety and security precautions and programs;
 - iii. Temporary Project facilities and utilities;
 - iv. Weather and fire protection;
 - v. Scaffolding and equipment;
 - vi. Materials and services to be used commonly by the Contractor and Subcontractors and requiring the Contractor to provide assistance in the utilization of any applicable equipment system;
 - vii. Preparation of operation and maintenance manuals; and
 - viii. Training of CMHA personnel for operation and maintenance of the Project
- B. The CMHA Construction Contract General Terms and Conditions shall not be superseded or amended by Drawings and Specifications, unless so provided in Supplementary Conditions.

23.1.97. Surety

- A. A Person providing a Bid Guaranty or a Bond to a Bidder or a Contractor, as applicable, to indemnify CMHA against all direct and consequential damages suffered by failure of the Bidder to execute the Contract, or of the Contractor to perform the Contract and to pay all lawful claims of Subcontractors, Material Suppliers and laborers, as applicable.

23.1.98. Substantial Completion

- A. The stage in the progress of the Work when the Work (or designated portion of the Work for which CMHA has agreed to take Partial Occupancy) is sufficiently complete in accordance with the Contract that CMHA can utilize the Work for its intended use, as determined by CMHA.
- B. The issuance of a certificate of occupancy or partial certificate of occupancy (if applicable) is a condition precedent to the achievement of Substantial Completion.

23.1.99. Substitution

- A. An article, device, material, equipment, form of construction, or other item, proposed by a prospective Bidder prior to the bid opening and approved by the A/E by Addendum, for incorporation or use in the Work as being functionally and qualitatively equivalent to essential attributes of a Basis of Design or Acceptable Component specified in the proposed Contract Documents.

23.1.100. Unit Price

- A. The cost of providing a unit of Work including labor, materials, services, and associated expenses.

23.1.101. Work

- A. The labor, materials, workmanship, manufacture or fabrication of components, equipment, and services, individually or collectively which are required by the Contract Documents, to be performed, installed, or provided by the Contractor for the Project.
- B. The furnishing of all material, labor, detailing, layout, supplies, plants, tools, scaffolding, transportation, temporary construction, superintendence, demolition, and all other services, facilities and items reasonably necessary for the full and proper performance and completion of the requirements of the Project as set forth in the Contract Documents, and items reasonably inferable therefrom and consistent therewith for the proper execution and completion of the construction and other services required by the Contract Documents, whether provided or to be provided by the Contractor or a Subcontractor, or any other entity for whom the Contractor is responsible, and whether or not performed or located on or off of the Site.



**INVITATION FOR BIDS
MBE / WBE PARTICIPATION REPORT**

PARTICIPATION REPORT

MINORITY BUSINESS ENTERPRISE (MBE) WOMEN BUSINESS ENTERPRISE (WBE)

Contract / PO#: _____

Please list below the names of all firmly committed MBE and WBE subcontractors that will work on the project, their MBE/WBE Status, the dollar amount, and the percentage of total contract amount that will be performed by the entities. The MBE/WBE participation can include subcontracts or purchases of services, materials and supplies directly related to the contract.

(Please check one) _____ Proposed _____ Amended _____ Final

	MBE	WBE	Name of Subcontractor(s)	Contract Amount \$ Amount	% Percentage
1	☐	☐	_____	\$ _____	_____ %
2	☐	☐	_____	\$ _____	_____ %
3	☐	☐	_____	\$ _____	_____ %
4	☐	☐	_____	\$ _____	_____ %
5	☐	☐	_____	\$ _____	_____ %
6	☐	☐	_____	\$ _____	_____ %
7	☐	☐	_____	\$ _____	_____ %
8	☐	☐	_____	\$ _____	_____ %
9	☐	☐	_____	\$ _____	_____ %
10	☐	☐	_____	\$ _____	_____ %
11	☐	☐	_____	\$ _____	_____ %
12	☐	☐	_____	\$ _____	_____ %
Total MBE Dollar Amount and Percentage of Contract				\$ _____	_____ %
Total WBE Dollar Amount and Percentage of Contract				\$ _____	_____ %

Fill with legible block letters

Signature: _____

Contact Person: _____

Company Name: _____

Date: _____



INVITATION FOR BIDS SECTION 3 RESIDENTS AND BUSINESS CONCERNS

S3 RESIDENTS AND BUSINESS CONCERNS

MINORITY BUSINESS ENTERPRISE (MBE) & WOMEN BUSINESS ENTERPRISE (WBE)

Prospective Business Vendor:

Section 3 is a provision of the Housing and Urban Development (HUD) Act of 1968 that helps foster local economic development, neighborhood economic improvement, and individual self-sufficiency. The Section 3 program requires that recipients of certain HUD financial assistance, to the greatest extent feasible, provide job training, employment, and contracting opportunities for low- or very low-income residents in connection with projects and activities in their neighborhoods.

Anyone claiming to be a Section 3 Business Concern shall be required, as set forth by procedure, to provide evidence of such status. Section 3 Business Concerns claiming Section 3 Preference status must meet that status at the time the bid, Bid or proposal is submitted to CMHA.

If you need any assistance or help regarding Section 3, feel free to contact us at Section3@cintimha.com

Section 3 Clause

- A. The work to be performed under this contract is subject to the requirements of section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (section 3). The purpose of section 3 is to ensure that employment and other economic opportunities generated by HUD assistance or HUD-assisted projects covered by section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing.
- B. The parties to this contract agree to comply with HUD's regulations in 24 CFR part 75, which implement section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the part 75 regulations.
- C. The contractor agrees to send to each labor organization or representative of workers with which the contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the contractor's commitments under this section 3 clause, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notices shall describe the section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s) taking applications for each of the positions; and the anticipated date the work shall begin.



INVITATION FOR BIDS

SECTION 3 RESIDENTS AND BUSINESS CONCERNS

- D. The contractor agrees to include this section 3 clause in every subcontract subject to compliance with regulations in 24 CFR part 75, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this section 3 clause, upon a finding that the subcontractor is in violation of the regulations in 24 CFR part 75. The contractor will not subcontract with any subcontractor where the contractor has notice or knowledge that the subcontractor has been found in violation of the regulations in 24 CFR part 75.
- E. The contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the contractor is selected but before the contract is executed, and (2) with persons other than those to whom the regulations of 24 CFR part 75.9 require employment opportunities to be directed, were not filled to circumvent the contractor's obligations under 24 CFR part 75.9
- F. Noncompliance with HUD's regulations in 24 CFR part 75 may result in sanctions, termination of this contract for default, and debarment or suspension from future HUD assisted contracts.
- G. In the event of a determination by the Executive Director or his/her designee that the Contractor is not in compliance with the section 3 clause or any rule, regulation, or report submission requirements of the CMHA, this contract may be canceled, terminated, or suspended in whole or in part, and the Contractor may be declared ineligible for further CMHA contracts for a period of one to three years.
- H. Section 3. The work to be performed under this Agreement is subject to the requirements of Section 3. The Parties agree to comply with HUD's regulations in 24 C.F.R. part 75, which implement Section 3 and hereby certify to the best of their knowledge that they are under no contractual or other impediment that would prevent them from compliance. The Authority shall monitor the Developer's compliance from time to time during the Project. The Developer agrees to require all Subcontractors to the greatest extent feasible to comply with Section 3 and the regulations promulgated in 24 C.F.R. part 75, and agrees to take appropriate action upon a finding that the Subcontractor is in violation of the regulations in 24 C.F.R. part 75. The Developer will not contract with any Subcontractor where the Developer has notice or knowledge that the Subcontractor has been found in violation of the regulations in 24 C.F.R. part 75.
- I. Number. The Developer agrees to meet the following Section 3 benchmarks of 25/5 (25% Section 3 Total Labor Hours / 5% Targeted Section 3 Total Labor Hours) and the stated percentages when selecting Subcontractors for the Project: (i) at least twenty percent (20%) of the general construction Subcontractors to qualify as a MBE Subcontractor; (ii) at least five percent (5%) of the general construction to qualify as a MBE Subcontractor (iii) at least ten percent (10%) of the construction contract Subcontractors to qualify as Section 3 Subcontractors. Additionally, any hiring or training opportunities generated should be provided to Section 3 and Targeted Section 3 workers to the greatest extent feasible. The list of proposed Subcontractors, including the MBE, WBE and Section 3 Subcontractors, shall be submitted to the Authority for approval prior to the Closing.



INVITATION FOR BIDS SECTION 3 RESIDENTS AND BUSINESS CONCERNS

- J. CMHA is committed to fostering neighborhood economic improvement and the self-sufficiency of its residents. This is done through taking proactive steps to hire local low-income persons and to award contractors to business that are registered Section 3 businesses. Therefore, CMHA strives to ensure that at least fifteen percent (15%) of all subcontracts are awarded to Section 3 businesses.
- K. In accordance with the findings of the Congress, as stated in section 3, that other economic opportunities offer an effective means of empowering low-income persons, a recipient is encouraged to undertake efforts to provide to low-income persons economic opportunities other than training, employment, and contract awards, in connection with section 3 covered assistance.
- L. The Developer shall require all Subcontractors to send to each labor organization or representatives of workers with which such Subcontractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the Developer's and/or Subcontractor's commitments under Section 3, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. Each Subcontractor shall certify to the Developer that any vacant employment positions, including training positions, that are filled (i) after a Subcontractor is selected but before the relevant contract is executed and (ii) with persons other than those to whom the regulations of 24 C.F.R. Part 75 require employment opportunities to be directed, were not filled to circumvent the Subcontractor's obligations under 24 C.F.R. Part 75 and the Developer shall certify to the Authority that it has obtained all such certifications.
- M. With respect to work performed in connection with section 3 covered Indian housing assistance, section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450e) also applies to the work to be performed under this contract. Section 7(b) requires that to the greatest extent feasible (i) preference and opportunities for training and employment shall be given to Indians, and (ii) preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned Economic Enterprises. Parties to this contract that are subject to the provisions of section 3 and section 7(b) agree to comply with section 3 to the maximum extent feasible, but not in derogation of compliance with section 7(b).

Assurance of Compliance Training, Employment, and Contracting Opportunities

The project assisted under this contract is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 170u. Section 3 requires that to the greatest extent feasible, newly created opportunities that are generated by the awarding of this contract be given to:

- Section 3 Workers (25% minimum goal of labor hours) upon their qualifications.
- Section 3 Targeted Workers (5% Minimum of labor hours)

Notwithstanding any other provision of this contract, the applicant shall carry out the provisions of said Section 3 and the regulations issued pursuant thereto by the Secretary set forth in 24 CFR Part 75, and all applicable rules and orders of the Secretary issued thereunder prior to the execution of this contract. The



INVITATION FOR BIDS SECTION 3 RESIDENTS AND BUSINESS CONCERNS

requirements of said regulations include but are not limited to development and implementation of a Section 3 Action Plan/Strategy for utilizing Section 3 Business Concerns; the making of a good faith effort, as defined by the regulation, to provide training, employment and business opportunities required by Section 3; and incorporation of the “Section 3 Clause” specified by Section 75.9 and 75.17 of the regulations in all contracts for work in connection with the project. The applicant and recipient agency certifies and agrees that it is under no contractual or other disability which would prevent it from complying with these requirements.

Compliance with the provision of Section 3, the regulations set forth in 24 CFR Part 75, and all applicable rules and orders of the Secretary issued thereunder prior to approval by the Government of the application of this contract, shall be a condition of the Federal financial assistance provided to the project, binding upon the applicant, its contractors and subcontractors, its successors, and assigns to the sanctions specified by the contract, and to such sanctions as are specified by 24 CFR Section 75.

Action Plan Submission

The Section 3 Action Plan is a requirement for contracting opportunities with CMHA. The Section 3 Action Plan must indicate/describe the proposed strategies for achieving the Section 3 training and/or employment goals, and subcontracting numerical goals, when and if newly created opportunities are generated upon awarding of contracts. Failure to submit the Section 3 Action plan may jeopardize the proposal/bid up to and including the possibility of said proposal/bid being deemed non-responsive.

Please review and complete the Section 3 Action Plan - Opportunities Strategies in the *Bid*. All Sections need to be completed. This information will help to assist you in formulating your Section 3 Action Plan. You will need to address each question and check the appropriate boxes in regards to how your company will strive to achieve Section 3 Compliance to the “greatest extent feasible”. Please identify individual(s) responsible for planning, implementing and tracking the projects’ Section 3 training, employment and/or contracting goals.



INVITATION FOR BIDS PREVAILING WAGES CLAUSE

TO THE CINCINNATI METROPOLITAN HOUSING AUTHORITY (CMHA)

In submitting this Bid, I acknowledge that:

- A. The Prevailing Wages shall be paid for a legal day's work to laborers, workmen or mechanics engaged in work under this Contract, at the site of the Project, in the trade or occupation listed.
- B. The Wage Determinations provided shall be closely monitored by the contractor/bidder/Proposer for any modifications until the actual construction work begins locking in the wage determination for the duration of the contract. Wage determinations and modifications can be monitored and obtained at www.wdol.gov. Failure to include the current wage determination will not relieve the contractors of potential wage liabilities.
- C. It shall be the Prime Contractor's responsibility to verify the accuracy of the reported wages, including his subcontractors.
- D. It shall be the Contractors responsibility to be certain that all the classifications needed to accomplish the contract fall underneath one of the classifications listed on the Wage Determination provided in the scope of work.
- E. In the event that a required classification is not listed, a contractor may submit a request for an additional classification. Remember the request is not valid unless the Department of Labor approves it. There will be no justification for an adjustment to a contract price due to an increased wage rate. The contractor should have been aware of any particular skilled trades that were not included in the original wage determination and thus accepted any risk that DOL would "conform" a pay rate higher than what they estimated when they priced their proposal. The contractor is responsible to propose wage/benefit rates that "bear a reasonable relationship" to the other classifications and rates listed on the wage determination.
- F. The following pages are the Prevailing Rates of Wages as ascertained by the State or other Agency for this Project.
- G. Listed below is a checklist of items required for Wage and Hour Compliance.
- H. Remember, prompt correction of deficiencies is essential. Failure to correct in a timely manner will be the withholding of payments on your contract until the deficiencies are corrected.



INVITATION FOR BIDS PREVAILING WAGES CLAUSE

I. For your convenience listed below is a checklist of items required:

- ☐ Appointment of Paymaster
- ☐ Equal Employment Opportunity Affirmative Action Policy Statement (*EEOAAPS*)
- ☐ Equal Employment Opportunity Compliance Certificate (*EEOCC*)
- ☐ Letter of Understanding
- ☐ General and Subcontractors form (*if applicable*)
- ☐ Employment Utilization Report (*upon completion*)
- ☐ Section 3 Form (*if applicable*)
- ☐ Weekly certified payrolls that include:
 - ☐ Contractor's Name
 - ☐ Contractor's Address
 - ☐ Payroll #
 - ☐ Week Ending Date
 - ☐ Project and Location
 - ☐ Contract or Purchase Order No.
 - ☐ Name of Employee
 - ☐ Social Security Number
 - ☐ Address of Employee
 - ☐ No. of Exemptions
 - ☐ Work Classification
 - ☐ Calendar Days
 - ☐ Hours Worked
 - ☐ Total Hours
 - ☐ Rate of Pay
 - ☐ Gross Amount Earned
 - ☐ Taxes or Write 1099 across columns if employee files his own taxes
 - ☐ Statement of Compliance (back page of the payroll sheet)
 - ☐ One of the boxes checked indicating if fringes benefits are paid in cash or approved program
 - ☐ Contract's Signature Certifying Payroll

Fill with legible block letters

Signature: _____

Contact Person: _____

Company Name: _____

Date: _____



INVITATION FOR BIDS SCOPE OF WORK

PART 1 ADMINISTRATIVE

1.1 GENERAL

A. Gold Standard

In 2012, CMHA established its Gold Performance Standards which consist of the principles and values by which the Agency performs and how our partners, vendors, contractors and consultants are measured.

The Gold Performance Standards are: Respect, Timely, Exceptional, Initiative, Excellent, Quality, Accurate, Integrity, Value, Creativity, Accountability and Professionalism. It's very imperative that our partners, vendors, contractors and consultants abide by these standards that have been established.

B. CMHA's Vendor Registration

1. The Contractor shall register as a CMHA's Vendor if not one already. To complete CMHA's vendor registration packet visit www.cintimha.com under Business Opportunities / Vendor Registration.

C. Prevailing Wages

1. The Contractor is responsible to consider the Prevailing Wage determination. The Attached Wage Determination can be subject to change from the time of contractor walk through to the date the bid is due. Typically, the wage rates are updated/revised/modified on Friday's every week. To monitor the Wage Determination visit: www.wdol.gov

D. Permits

1. The Contractor Shall Obtain all necessary permits for construction activities in accordance with Federal, State and Local Jurisdiction.

E. Existing conditions

1. The contractor shall field verify all existing condition prior to quoting. Contractor is responsible to examine the job conditions and field measurement, distances, elevations, clearances, etc. and base their quote and work on verified conditions. No Change Order will be approved for modifications/alterations required to existing conditions that are

apparent on the drawings and specifications and visible during the walk through.

F. Drawings and Specifications

1. The Contractor is responsible for comprehending the specifications, plans and becoming familiar with the site location and performing/completing all the work in the specifications at high standards in a professional manner.

G. Contract Management

1. The Contractor shall provide a Construction Schedule and all applicable insurances at the Pre-Construction meeting before starting construction.
2. The contractor shall furnish all labor, materials, tools, equipment and devices to complete the work as specified in scope of work.
3. The contractor is responsible for paying all utilities during construction ie. electric power, natural gas and water. The contractor shall provide those not available on the property and needed for construction.

H. Site Management

1. The Contractor shall provide the Construction Project Manager and the Property Manager (PM) with 48-hour advance notice prior to the start of work.
2. The Unit will be
☐ vacant during construction. ☐ occupied during construction.
3. The Building will be
☐ vacant during construction. ☐ occupied during construction.
4. Construction working hours are 8:00 a.m. - 4:00 p.m. Monday thru Friday. Weekend work is prohibited if not approved in writing.
5. The Contractor shall coordinate and cooperate with surrounding residents who currently reside in the houses and buildings to minimize conflicts. The contractor is fully responsible for properly securing the house at the end of the work day.
6. The Contractor shall keep areas under construction clean on a daily basis. All un-used construction material shall be removed from site at the end of each work day. The contractor is prohibited from using any dumpsters and/or totters that are on site. The contractor shall clean all areas that are affected by the renovation (i.e. mechanical room,



INVITATION FOR BIDS SCOPE OF WORK

- public walk ways, driveway, etc.)
7. The Contractor shall secure the construction site. The Contractor shall secure and protect all materials, tools and equipment stored on site and all work completed. CMHA assumes no liability for these materials, tools and equipment that may become missing and/or damaged and not guarantees that the property's video surveillance captures the incident, if available.
 8. The contractor may store materials, tools and equipment on site if approved in writing and as instructed by the owner.
 9. The contractor shall have at least one person in charge and on site during the duration of the project. This person shall be familiar with the project scope and daily construction activities and other persons in the work area.
 10. The contractor shall maintain all lawns/sites within the area contracted for the duration of the project. Lawns shall be cut a minimum of once every 10 days from March through October. The contractor shall also be responsible for the removal of all rubbish, debris limbs, leaves, etc., within the area.
 11. The Contractor shall coordinate with owner location of barriers and separations as necessary to protect occupied areas from noise, dust or other disruptive activities.
 12. The Contractor shall perform the work with a minimum of disruption by noise, odors, dust or other disruptive causes to owner's normal operations.
 13. The contractor is responsible for any damages that may occur to the existing exterior and interior finish (i.e. landscaping, exterior façade, grass, concrete walks, asphalt/concrete paving, drywall, flooring materials, wall base, wall/door finishes, etc.) during the construction duration.
 14. Protect all adjacent surfaces or finishes during all work. Restore affected surfaces if damaged during construction.
 15. CMHA does not furnish janitorial supplies. However, the contractor is encouraged to contact the CMHA Materials Controls Department or Field Representative to get a list of janitorial products commonly used by CMHA.
 16. The contractor is responsible for all trash and debris in the units, and in the front, sides

and rear yards.

I. End of Construction

1. The contractor is to submit an Operation and Maintenance manual at the end of the project, one hard copy and one digital copy in PDF format. The Operation and Maintenance manual shall include manufacturer manual and warranty of all equipment and/or devices used/purchased for this project.
2. The Contractor shall warranty all material and workmanship for a period of one year after acceptance.
3. The contractor shall perform all tests, adjustments, etc. as required by equipment manufacturer.
4. The Contractor shall perform all tests, adjustments, etc. as required on all new installed devices. The equipment and devices are to be 100% operable/functional after installation.

PART 2 CONTRACTOR RESPONSABILITIES

1. The Contractor shall:
 - i. Verify quantities to successfully complete the project.
 - ii. Coordinate with building operations and residents to minimize the interference of day to day activities.
 - iii. Coordinate with building manager location of dumpster.
 - iv. Coordinate with any other contractor working in the building. CMHA has several projects ongoing in this building.
 - v. The contractor or any of its personnel shall not enter any unit, at any time. No exceptions.
 - vi. Smoking is not permitted inside the building or its surrounding areas.
 - vii. Keep all areas clean and free of debris during construction activities and after hours.
 - viii. The contractor, subcontractors, material men, or suppliers shall use only unmanufactured articles, materials, and supplies that have been mined or produced in



INVITATION FOR BIDS SCOPE OF WORK

the United States; and manufactured articles, materials, and supplies that have been manufactured in the United States substantially all from articles, materials, or supplies mined, produced, or manufactured in the United States.

PART 3 MAKE READY PROCEDURES



APPLY



DO NOT APPLY

3.1 GENERAL (All units expect as noted)

A. Preparation and Finishing

2. Remove all hangers, hooks, mails, tape, contact paper, wall paper, borders, etc.
3. Remove any obvious imperfections in walls or ceilings.
4. Remove any imperfections around fixtures of any sort and outlets. Do not paint electrical fixtures, switches, outlets or cover plates.
5. Wipe debris off all surfaces. This includes but is not limited to webs, dust, dirt, insect eggs and feces.
6. Paint all walls, ceilings, doors, window sills, trim, etc.
7. Drywall should be prepped for level 4 drywall finish. This will require drywall to be skim coated to provide smooth finish prior to painting.
8. In the kitchen, wash all surfaces of excessive smoke or grease damage. Special care shall be given to cleaning the area behind the range and refrigerator.
9. Properly use drop clothes.
10. Remove excessive debris and dust from heat registers before painting them.
11. Caulk all edges of countertops, window frames, door frames, kitchen cabinets, the base of all walls that connect apartments and public spaces, etc.
12. Cleaning of paint and drywall utensils and tools of any kind are not permitted in the apartment unit(s).
13. The contractor shall inspect all surfaces requiring painting to verify the work has been completed before turning over the unit as PAINTED.
14. Paint to use:
 - i. Primary wall paint: Promar 200 Interior Latex Eggshell, SW 7015
 - ii. Bathroom paint: Promar 200 Interior Latex Semi-Gloss, SW 7015



INVITATION FOR BIDS SCOPE OF WORK

iii. Ceiling paint: Promar 200 Interior Latex Flat, SW 7006

iv. Door and trim paint: Promar 200 Interior Latex Eggshell, SW 7006

3.2 MAINTENANCE (All units expect as noted)

A. Leaking Faucets

1. All faucets and toilets shall be operable and without leaks.
2. All drains shall be open and without leaking waste lines.
3. Laundry station(s) shall be operable, open and without leaks.

B. Windows

1. Clean all windows, doors, frames and seals, including front and back storm doors, and including handles and knobs. They should open, close and be able to lock.
2. Remove and repair any damage from any old hardware remaining from previous blinds and shades no longer in use.
3. Windows shall have vinyl 1" mini-blinds in working condition.
 - i. All screens should be cleaned and in place without any rips or holes.
4. All missing screen shall receive new matching screens.

C. Doors

1. Make sure that all storm and prime doors are in place and operable (open, close and are able to lock).
2. All doors (interior, exterior, closets and cabinets) must be able to open and close properly without any missing hardware.
3. Replace or repair wheels, tracks, hardware, door knobs, etc. so that doors are operable and function properly.
4. Exterior Doors must be cleaned both on the inside and outside, including screen doors/storm doors.
5. Exterior doors must be painted as necessary.
6. Interior doors must be painted or shellacked as necessary.
7. Check door sweeps and weather stripping. Replace where needed.
8. Install doorstops throughout the unit.



INVITATION FOR BIDS SCOPE OF WORK

9. Busted doors must be replaced. A busted door may consist of veneer coming off, excessive holes, cracks, or anything beyond repair. If the replacement of the door is in question, the property manager will have the final say in determining whether or not to replace it. It is the contractor's responsibility to ensure a proper fit within the frame, the holes are accurately drilled for hinges, door knob and lockset. Should the contractor damage the door during this process, they will be held financially responsible and/or required to replace the door with new like-kind door.
10. Do not paint door hardware, if painted previously paint must be removed.

D. Cover Plates

1. Replace (provide where missing) all cracked or damaged electrical/cable/telephone cover plates.
2. Do not paint cover plates.

E. Stair Treads

1. All stair treads shall be securely in place and without any cracks, chips, breaks or tripping hazards. No tripping hazards.
2. All stair treads must be cleaned thoroughly.

F. Electric Fixtures and Outlets

1. Clean all interior and exterior light fixtures, light shades, globes and switch plates and switches.
2. Fixtures shall be free of fingerprints, marks, dust and insects.
3. All switches shall be operable.
4. All outlets (including GFCI) shall be operable.
5. All exterior light fixtures, doorbells, etc. shall be operable.

G. Smoke Alarms/Detector

1. Remove all smoke alarms/detectors and install new per all applicable codes and regulations.
2. All smoke alarms/detectors should be properly installed and working.
3. Smoke alarms should not be painted or have stickers or other decorations present.
4. Smoke alarm/detector location guidelines



INVITATION FOR BIDS SCOPE OF WORK

- i. If mounted on the ceiling, it must be more than 4 inches from the wall.
- ii. It cannot be closer than 4 inches or more than 12 inches from the ceiling if mounted on the wall.
- iii. Smoke alarms should not be installed near windows, doors, or ducts where drafts might interfere with their operation.

H. Carbon Monoxide (CO) Alarms/Detector

1. Remove all smoke alarms/detectors and install new per all applicable codes and regulations.
2. Carbon Monoxide Detection shall be installed in dwelling units containing a fuel-burning appliance or fireplace.
3. Carbon Monoxide detection shall be included in any dwelling units with attached private garages.
4. Carbon Monoxide detectors shall be installed in dwelling units outside each sleeping area and within 10 ft. of the bedroom. If a fuel-burning appliance is installed in the bedroom, a CO detector must be installed in the bedroom.

I. LVT / VCT Floors

1. In locations where the floor tile terminates between rooms, provide a transition strip.
2. Remove/replace all damaged, missing and/or defective wood/vinyl baseboards, toe strips or transition strips.

J. Ceramic Tile

1. Replace any damaged drywall/green board behind ceramic wall tile.
2. Repair or replace any loose, broken or missing ceramic wall tile. Replace all loose, broken or missing grout (match existing). Remove/replace or provide caulk at all tub/ceramic tile locations that terminate at wall surfaces.

K. Water Heater(s)

1. Inspect water heater(s) for proper operation and exhaust venting. Report any problems to the Owner's Field Representative.
2. Furnace(s) and Boiler(s)



INVITATION FOR BIDS SCOPE OF WORK

3. Inspect furnace(s) for proper operation and exhaust venting. Report any problems to the Owner's Field Representative.
4. Inspect boiler(s) for proper operation and exhaust venting. Report any problems to the Owner's Field Representative.
5. Inspect thermostat(s) for proper operation. Report any problems to the Owner's Field Representative.
6. Vacuum clean all heating and air conditioning equipment, grills, registers, etc. Report any problems (damaged or missing items) to the Owner's Field Representative.

L. Appliances

1. Range Hood – Inspect the range hood for proper operation (fan, light and exhaust venting if required). The hood should have all of its parts and hardware such as filters, knob, etc. Report any problems to the Owner's Field Representative.
2. Range and Refrigerator – The existing ranges and refrigerators on site shall be unwrapped and installed (put in place) and made ready for use (i.e. plugged-into outlet, connected to gas supply piping, etc.). Report any problems to the Owner's Field Representative.
3. Must operate properly with all parts and hardware on it.
4. Gaskets should seal properly
5. All lights must be working

M. Exterior and Unit Entry Doors

1. All doors must open and close securely. All doors shall have proper and functioning hardware. Report any problems to the Owner's Field Representative.
2. Inspect all doors for proper door sweeps and weather stripping. Remove/replace and/or provide new door sweeps and weather stripping where required.
3. Remove/replace and/or provide new door stops throughout all units.

N. Closets

1. Inspect all closets and verify the proper installation of shelving and clothes rods. If any are damaged or missing, report the information to the Owner's Field Representative.
2. Make sure all closet poles and shelves are installed.



INVITATION FOR BIDS SCOPE OF WORK

3. Closets shall be cleaned and free of debris.

O. Stoppers/Strainers

1. Provide a stopper or strainer in every sink.

P. Bathroom Fixtures

1. Inspect all bathrooms to ensure that they have in place a soap dish, towel bars and a medicine cabinet. If any of these items are missing, report this information to the Owner's Field Representative.

Q. Bathroom, Laundry, and Kitchen Cabinetry

1. All elements should be inspected when evaluating cabinets, including doors, drawers, hinges, knobs, drawer guides or slides, shelves, and cases or boxes.

R. Caulking / Sealing of the Unit

1. Caulk where needed on counter tops, window frames, door frames, kitchen cabinets etc.
2. In apartments caulk the base of all walls that connect two units.
3. Caulk around breaker box.
4. IPM (Integrated Pest Management) practices must be followed:
5. Seal all openings, cracks, and voids where possible including but not limited to around conduits and pipes
6. Caulk all baseboards.
7. Caulk between kitchen cabinet trim and cabinets if your I.D. badge can slide between the trim and the cabinet.
8. Secure all loose material to prevent harborages (e.g., loose trim boards, loose hinges, uncaulked trim).
9. Clear silicone must be used inside all cabinets/drawers and where cove base/baseboard meets floor.
10. Paintable caulking must be used where cabinets meet wall and where cove base/baseboard meets wall.
11. All caulking color should match surrounding surface.
12. Any voids larger than 1/4" cannot be caulked, additional support is needed, examples:
 - i. 1/4" round wood trim



INVITATION FOR BIDS SCOPE OF WORK

- ii. Luan board
- iii. Expandable foam
- iv. Expanded foam must be trimmed or sanded
- v. Various types of wood trim
- vi. Heat tape (range hoods).

S. Painting/Preparation and Finishing

1. Remove all hangers, hooks, nails, tape, contact paper, wallpaper, borders etc.
2. Take out any obvious imperfections in wall or ceilings.
3. Take out imperfections around fixtures of any sort and outlets.
4. DO NOT PAINT electrical fixtures, switches, outlets, cover plates, sprinkler heads, and escutcheon plates.
5. Remove debris and dust from within the heater registers and ductwork.
6. Use caulk where needed on counter tops, window frames, door frames, kitchen cabinet etc.
7. Inspect entire unit before you request approval for painting.

T. Painting

1. All painted surfaces will be repainted to provide a uniform finish and shall be free from runs. Work shall be performed in accordance with all the manufacturer's recommendations. The Contractor will be responsible for correcting at his/her expense any work not accepted by the Authority Staff.
2. Contractor shall scrape off all flaking and/or loose paint from ceiling, walls and trim, interior and exterior doors, and exterior windowsill surfaces. Where chipped paint exists, sanding will be performed by use of various grades of sandpaper to featheredge chipped areas to allow a smooth flow of paint and prevent further chipping.
3. Contractor shall perform surface preparation throughout unit on all walls and surfaces requiring painting for the application of paint; surfaces shall be prepared to be consistent with the existing surface. Contractor will paint the unit in accordance with the terms of this proposal and scope of work.



INVITATION FOR BIDS SCOPE OF WORK

4. All nails, screws, brackets, debris, etc., shall be removed. All holes in the walls, ceilings, doors, trim, etc., as well as cracks, will be properly filled, floated or caulked flush with existing surface. Finish will match all other existing finish work.
5. All doors and window trim must be painted. **DO NOT PAINT BUSTED DOORS.** Busted doors must be replaced, previously described. Doors include but are not limited to interior, exterior, and screen doors.
6. Each unit shall include a painted accent wall in the living room.
7. If range hoods are currently painted and range hood paint is peeling, flaking or bubbling, paint with heat-retardant paint, or replace range hood. **DO NOT** paint range hoods if not currently painted. Touch up any nicks or scrapes to appliances with appliance paint.
8. **DO NOT** paint electric boxes, breaker boxes, or cover plates unless previously painted.
9. Properly use drop cloths. Improper use could lead to termination of the contract and you will also be held liable for costs to restore floors, stairs, hardwood floors, VCT tile, ceramic tile, etc. Properly clean paint equipment and wall repair materials. Do not clean paint equipment in units. Protect all drains from clogging. Contractor may be held accountable for plumbing costs incurred due to Contractor's actions. **DO NOT** dispose of paint in trash chutes.

3.3 JANITORIAL (All units expect as noted)

A. Bathroom(s)

1. Clean ceramic tile walls and grout.
2. Clean ceramic tile floors and grout where applicable.
3. Clean and disinfect all bathroom fixtures including but not limited to: faucets, sink, toilet, bathtub, grab bars, knobs, medicine cabinet.

B. VCT Floors

1. Stripping Floors:
 - i. Use buffer to strip tile floors.
 - ii. Clean all corners under and/or around heat registers and vents.

- iii. Clean baseboards and cove base.
- 2. Sealing/Waxing:
 - i. Provide two coats of sealer and two coats of wax to the floors.

C. Carpet

- 1. Contractor shall furnish necessary equipment and materials/supplies to perform any carpet cleaning.
- 2. Contractor shall vacuum carpets both prior to and after cleaning carpets.
- 3. Carpet cleaning includes, but is not limited to, cleaning the carpet, spot treatment, moving furniture (if applicable), stain removal and carpet stretching (if required due to the water).

D. Wood floor

- 1. Clean wood floors and apply polyurethane.

E. Light Fixtures and Globes/Shades

- 1. Clean all light fixtures, light globes/shades, etc.

F. Windows/Frames and Doors/Frames

- 1. Clean all windows and frames.
- 2. Clean all doors and frame.

G. Kitchen

- 1. Stove
 - i. Clean the outside of the stove with degreasing soap or all-purpose cleaner.
 - ii. Use the degreaser or all-purpose cleaner on the knobs and handles as well.
 - iii. Use oven cleaner for the inside of oven door, inside of broiler, the pan and the oven interior.
 - iv. Clean drip pans and vent filters
 - v. Clean range hood.
- 2. Walls
 - i. Kitchen walls must be cleaned for excessive smoke or grease damage.
 - ii. The area behind the range must be cleaned as well.
- 3. Refrigerator



INVITATION FOR BIDS SCOPE OF WORK

- i. Contractor shall defrost, clean and dry refrigerator.
 - ii. Clean refrigerator using an all-purpose cleaner or any other cleaner that does not harm coating or gaskets.
 - iii. Clean excess dust from bottom and rear coil of refrigerator.
4. Cabinets/Sinks/Countertops
 - i. Clean all cabinets inside and outside.
 - ii. Clean sink and countertops.
 - iii. Cabinets, drawers and hinges shall be cleaned and free of debris.
5. Miscellaneous
 - i. Clean the outside of water heater.
 - ii. Contractors must ensure that units with basements are cleaned.
 - iii. Pressure wash garages, both interior and exterior.

3.4 PROTECTION AND CAUTIONS

1. Protect all adjacent surfaces or finishes during all work. Restore affected surfaces if damaged during construction.
2. CMHA does not furnish janitorial supplies. However, the contractor is encouraged to contact the CMHA Materials Controls Department or Field Representative to get a list of janitorial products commonly used by CMHA.
3. The contractor is responsible for all trash and debris in the units, and in the front, sides and rear yards.

PART 4 UFAS STANDARDS



APPLY

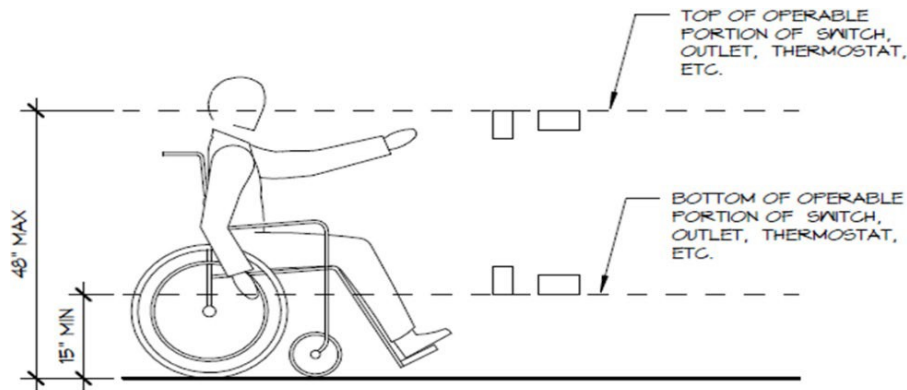


DO NOT APPLY.

4.1 Follow all dimensions and clearances for American National Standard Institute (ANSI) ICC A117.1-2009 code compliance.

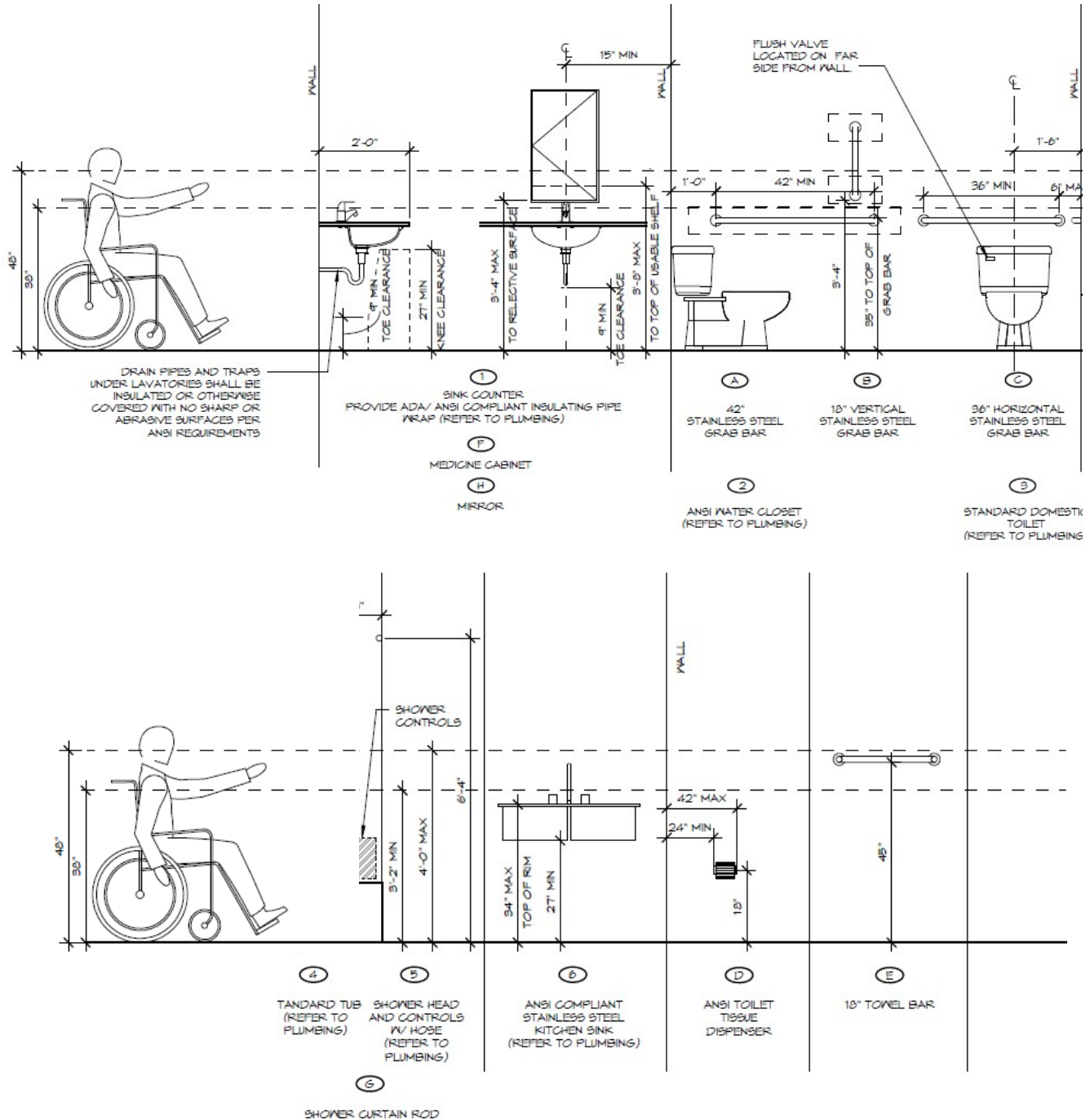
1. **Bathtub & Shower Controls:** Install controls within the space indicated.
2. **Sinks:** Install all bathroom sinks at or below, as approved, the maximum mounting heights and with floor clearances as indicated.
3. **Closets:** Install double hardware for shelving at 42" and 68". Install shelf at 42".

4. **Blocking for grab bar installation:** Install as indicated on detail. Blocking must be able to support 250 lb. of force applied to the grab bar.
5. **Controls outlets, switches, etc.:** Locate all controls, electrical panels, switches, receptacles and other operable equipment as indicted.
6. **Fixtures:** Mounting heights shall be as indicated.
7. **Kitchen Cabinets:** Install upper cabinets so that the lowest shelf is at a maximum of 48" A.F.F. The countertop height and the rim of the sink height shall be at a maximum of 34" A.F.F.
8. **Kitchen cabinet door pulls & handles:** Install Door pulls or handles for the upper cabinets as close as possible from the bottom of the cabinet door. Install Door pulls or handles for the lower cabinets as close as possible from the top of the cabinet door.
9. Mount all equipment's, fixtures, receptacles, outlets, switches, thermostats and controls as shown.
10. Diagrams below are not to scale.



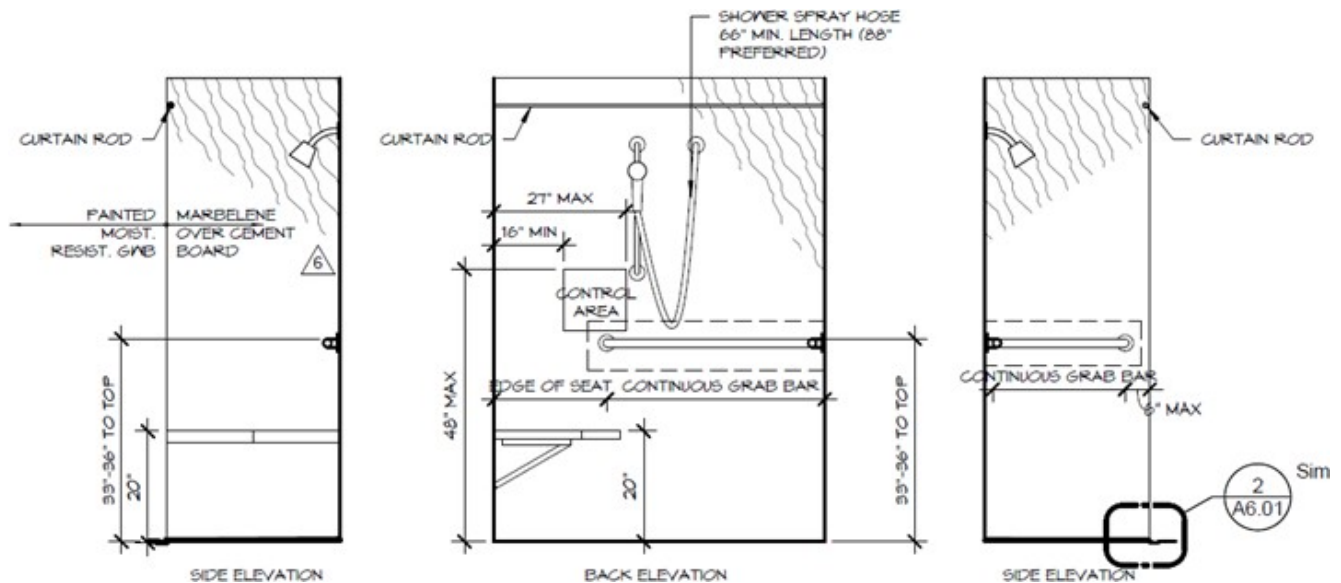
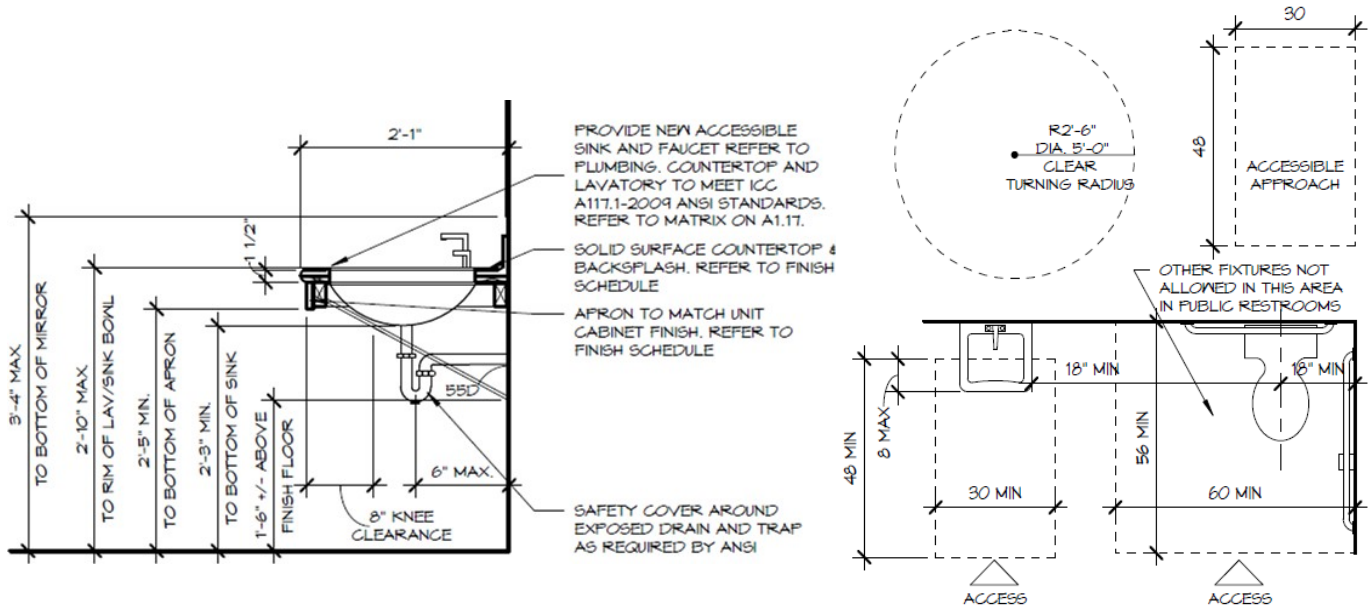
Reach Ranges

INVITATION FOR BIDS SCOPE OF WORK



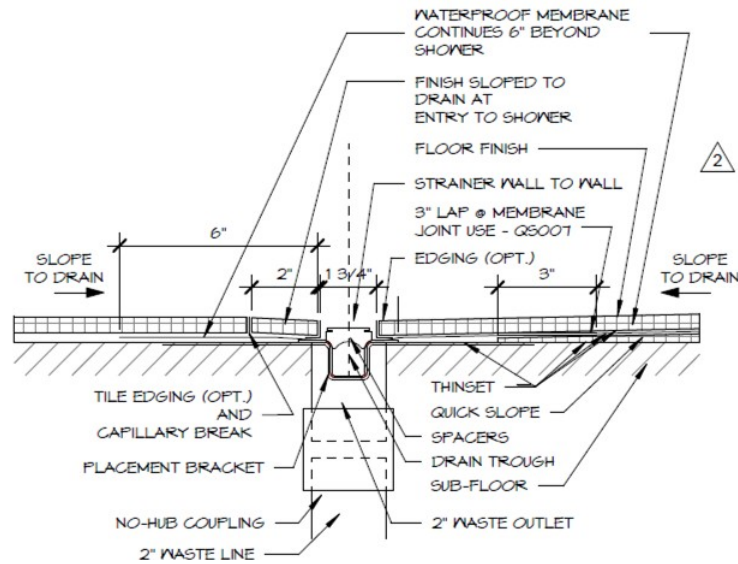
Bathroom Clearances

INVITATION FOR BIDS SCOPE OF WORK

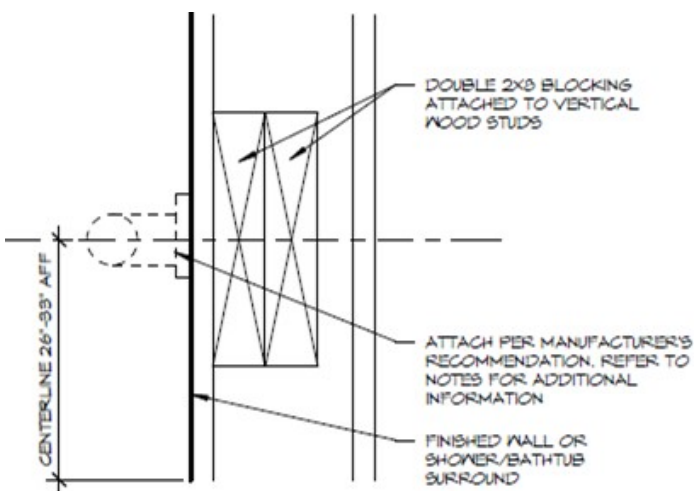


Bathroom Clearances

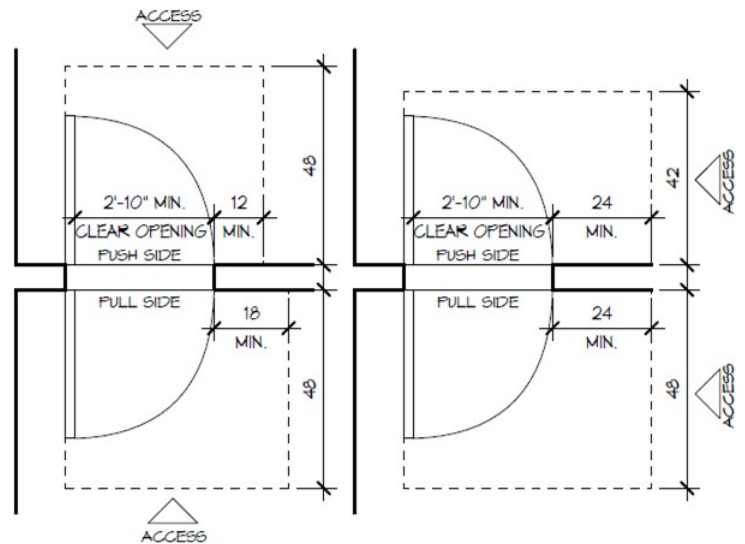
INVITATION FOR BIDS SCOPE OF WORK



Shower Trench Detail



Grab Bar Blocking Detail



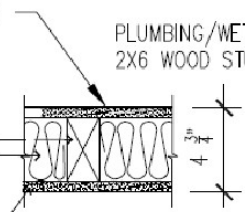
Door Clearances

5/8" FIRE-SHIELD GYP. BD. ON
2x4 WD. STUDS @ 16" O.C.
W/ 2x4 TOP & BOTTOM
PLATES

3 1/2" MINERAL WOOL OR
GLASS FIBER FOR STC 50

5/8" FIRE-SHIELD
GYPSUM WALLBOARD

PLUMBING/WET WALL SHALL BE
2X6 WOOD STUDS

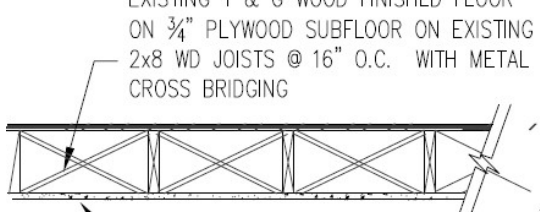


WALL DETAIL 1 @ DEMISING WALLS / UL-U305 GA WP 3605 (1HR) STC35

EXISTING T & G WOOD FINISHED FLOOR
ON 3/4" PLYWOOD SUBFLOOR ON EXISTING
2x8 WD JOISTS @ 16" O.C. WITH METAL
CROSS BRIDGING

NOTE: CROSS BRIDGING IS MISSING IN
SOME LOCATIONS- INSTALL 2"x1 1/2" WOOD
CROSS BRIDGING AT CENTER SPAN

AFTER REMOVAL OF ORIGINAL 1/2" GYPSUM BOARD- LAMINATE 2-
LAYERS OF 1/2" TYPE "X" DRYWALL APPLIED AT RIGHT ANGLES WITH 6d
NAILS, 1 7/8" LONG, .0915" SHANK, 1/4" HEADS 6" O.C.

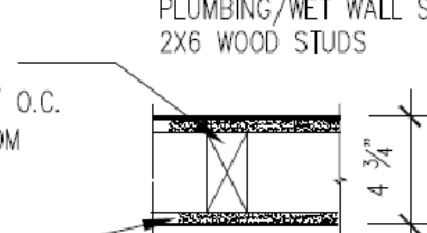


CEILING DETAIL 1

5/8" GYP. BD. ON
2x4 WD. STUDS @ 16" O.C.
W/ 2x4 TOP & BOTTOM
PLATES

5/8" GYPSUM BOARD.

PLUMBING/WET WALL SHALL BE
2X6 WOOD STUDS



WALL DETAIL 2 @ INTERIOR WALLS

APPLY GYP. BD. EITHER HORIZONTALLY OR VERTICALLY. INNER LAYER ATTACHED TO STUDS W/ 1
7/8" NAILS @ 6" O.C.; OUTER LAYER ATTACHED TO STUDS OVER INNER LAYER W/ 2 3/8" LONG NAILS
@ 8" O.C.. VERTICAL JOINTS LOCATED OVER STUDS. STAGGER ALL JOINTS IN FACE LAYER.
NAILS 6 D CEMENT COATED NAILS.

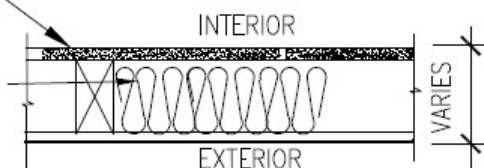
NOTE: AT ALL PLUMBING WALLS- USE MOLD TOUGH FIRECORE TYPE "X"
GYPSUM BOARD IN THICKNESS AS INDICATED FOR PARTITION

NEW 5/8" GYPSUM BD. ON EXISTING
2X WOOD STUDS

REPORT ANY WATER OR TERMITE
DAMAGED FRAMING TO THE ARCHITECT

PROVIDE NEW 3 1/2"
FIBERGLASS BATT INSUL.

REMOVE EXISTING EXT.
FINISH (SIDING OR STUCCO)
& SHEATHING-PROVIDE NEW
1/2" APA RATED EXT. GRADE
PLYWOOD & FINISH AS
SHOWN ON ELEVATIONS



EXISTING 2X WOOD FRAMING
TO REMAIN-UNLESS ON WET
WALLS-REPLACE ALL
FRAMING AT WET WALLS

KITCHEN EXTERIOR WALL 2X6 WOOD STUDS WITH EXTERIOR
FINISH AS INDICATED ON ELEVATIONS -PROVIDE NEW 3 1/2"
BATT INSULATION AND 5/8" GYPSUM BOARD AT INTERIOR.

WALL DETAIL 3 @ PERIMETER WALLS

APPENDIX A



AIA® Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the 18th day of December in the year 2024
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

Insert LLC name

1627 Western Ave.
Cincinnati, OH 45214

and the Contractor:
(Name, legal status, address and other information)

Insert Contractor name and address

for the following Project:
(Name, location and detailed description)

Insert Project name and address

The Architect:
(Name, legal status, address and other information)

Insert Project name and address

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

TABLE OF ARTICLES

1	THE CONTRACT DOCUMENTS
2	THE WORK OF THIS CONTRACT
3	DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
4	CONTRACT SUM
5	PAYMENTS
6	DISPUTE RESOLUTION
7	TERMINATION OR SUSPENSION
8	MISCELLANEOUS PROVISIONS
9	ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:

(Check one of the following boxes.)

- ☐ The date of this Agreement.
- ☒ A date set forth in a notice to proceed issued by the Owner.
- ☐ Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

(Check one of the following boxes and complete the necessary information.)

[X] Not later than 420 (Four hundred and twenty) calendar days from the date of commencement of the Work.

[] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

See Exhibit I: Unit Delivery Schedule and Liquidated Damages

Portion of Work	Substantial Completion Date
<i>(Row deleted)</i>	

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be **words** (\$), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
None	

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

§ 4.4 Unit prices, if any:
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit (\$0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

See Exhibit I: Unit Delivery and Liquidated Damages

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the 25th day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the 25th day of the following month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than forty-five (45) days after the Architect receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

Ten Percent (10.00%)

Init.

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

General Conditions, Builders Risk, Overhead, Profit and Bond

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

When at least Fifty Percent (50.00%) of the Work has been completed, (i) The Contractor may request that Fifty Percent (50.00%) of the amount retained on previous applications for payment be released by the Owner. 7.9.5. The Owner may, at its sole discretion, approve the request, effectively reducing the retainage from Ten Percent (10.00%) to Five Percent (5.00%) and (ii) the retainage for the balance of the work be reduced to Five Percent (5.00%). .

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner’s prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- 1** the Contractor has fully performed the Contract except for the Contractor’s responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- 2** a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner’s final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect’s final Certificate for Payment, or as follows:

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

- ☒ [X] Arbitration pursuant to Section 15.4 of AIA Document A201–2017
- ☐ [] Litigation in a court of competent jurisdiction
- ☐ [] Other *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner’s convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:

(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner’s convenience.)

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner’s representative:

(Name, address, email address, and other information)

Reema Ruberg, Treasurer

Insert LLC name

1627 Western Avenue

Cincinnati, OH 45214

§ 8.3 The Contractor’s representative:

(Name, address, email address, and other information)

***Insert Contractor
representative
information***

§ 8.4 Neither the Owner’s nor the Contractor’s representative shall be changed without ten days’ prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction

(Paragraphs deleted)

- .4 Drawings

Number	Exhibit
Drawing Log	Exhibit A

- .5 Specifications

Section	Exhibit
Specifications Log	Exhibit B

- .6 Addenda, if any:

Number	Exhibit
Schedule of Values	Exhibit C
Construction Schedule	Exhibit D
HUD Supplementary Conditions	Exhibit E
Section 3 Requirements	Exhibit F
Prevailing Wage Decision	Exhibit G
Const Contract Sales Tax Addendum	Exhibit H
Unit Delivery/Liquidated Damages	Exhibit I

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

- .7 Other Exhibits:

(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

AIA Document E204Th- 201 7, Sustainable Projects Exhibit. dated as indicated below:
(Insert the date of the £ 204-2017 incorporat4ed into this agreement)

The Sustainability Plan:

Title	Date	Pages

Supplementary and other Conditions of the Contract;

Document	Title	Date	Pages

.8 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™-2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreements. Any such documents should be listed here only if intended to be part of the Contract Documents.)

A201 2017

This Agreement entered into as of the day and year first written above.

OWNER (Signature)

CONTRACTOR (Signature)

Insert LLC name

Insert Contractor Name

By: _____
(Printed and title)

By: _____
(Printed and title)

Int.

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User Notes:

(1803057258)

(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

AJA Document E204Th'- 201 7, Sustainable Projects Exhibit. dated as indicated below:
(Insert the date of the £ 204-2017 incorporat4ed into this agreement)

The Sustainability Plan:

Title	Date	Pages

Supplementary and other Conditions of the Contract;

Document	Title	Date	Pages

.9 Other documents. if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™-2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreements. Any such documents should be listed here only if intended to be part of the Contract Documents.)

A201 2017

This Agreement entered into as of the day and year first written above.

OWNER (Signature)

CONTRACTOR (Signature)

Insert LLC name

Insert Contractor Name

By: _____

(Printed name and title)

By: _____

(Printed name and title)

Init.

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User Notes:

(1803057258)

Additions and Deletions Report for AIA® Document A101® – 2017

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 15:08:41 ET on 12/11/2024.

PAGE 1

AGREEMENT made as of the _____ day of _____ in the year _____ >

...

*** insert LLC name and address***

...

*** insert contract name and address***

...

*** insert project name and address***

...

*** insert architect name
and address***

PAGE 2

[☒] A date set forth in a notice to proceed issued by the Owner.

PAGE 3

[☒] Not later than 420 (Four hundred and twenty) calendar days from the date of commencement of the Work.

...

See Exhibit I: Unit Delivery Schedule and Liquidated Damages

...

...

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be _____ (\$ _____), subject to additions and deductions as provided in the Contract Documents.

...

None

...

None

...

See Exhibit I: Unit Delivery and Liquidated Damages

PAGE 4

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the 25th day of the month, the Owner shall make payment of the amount certified to the Contractor not later than the 25th day of the following month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than forty five (45) days after the Architect receives the Application for Payment.

...

Ten Percent (10.00%)

PAGE 5

General Conditions, Builders Risk, Overhead, Profit and Bond

...

When at least Fifty Percent (50.00%) of the Work has been completed, (i) The Contractor may request that Fifty Percent (50.00%) of the amount retained on previous applications for payment be released by the Owner. 7.9.5. The Owner may, at its sole discretion, approve the request, effectively reducing the retainage from Ten Percent (10.00%) to Five Percent (5.00%) and (ii) the retainage for the balance of the work be reduced to Five Percent (5.00%).

PAGE 6

[X] Arbitration pursuant to Section 15.4 of AIA Document A201-2017

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with ~~a building information modeling exhibit, AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit,~~ if completed, or as otherwise set forth below:

(If other than in accordance with ~~a building information modeling exhibit, AIA Document E203–2013,~~ insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

...

~~.4 Building information modeling exhibit, dated as indicated below:
(Insert the date of the building information modeling exhibit incorporated into this Agreement.)~~

~~.5~~

~~.4 Drawings~~
Number

Title

Date

Number

Drawing Log

Exhibit

Exhibit A

~~.6~~

~~.5 Specifications~~
Section

Title

Date

Pages

Section

Specifications Log

Exhibit

Exhibit B

~~.7~~

~~.6 Addenda, if any:~~
Number

Date

Pages

Number

Schedule of Values

Construction Schedule

HUD Supplementary Conditions to
the Construction Contract

Section 3 Requirements

Prevailing Wage Decision

Construction Contract Sales Tax

Unit Delivery/Liquidated Damages

Exhibit

Exhibit C

Exhibit D

Exhibit E

Exhibit F

Exhibit G

Exhibit H

Exhibit I

...

~~.8~~ .7 Other Exhibits:

~~.9~~ .8 Other documents, if any, listed below:

...

A201 2017

...

—

OWNER *(Signature)*

CONTRACTOR *(Signature)*

Insert LLC name

Insert Contractor Name

Certification of Document's Authenticity
A/A® Document D401rn - 2003

I. *****insert contractor representative name and title*****, hereby certify to the best of my knowledge, information and belief, that I created the attached final documents simultaneously with its associated Additions and Deletions Report and this certification at *****insert date and time***** under Order No. 2114515930 from AJA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AJA Document A101™- 2017, Standard Form of Agreement between Owner and Contractor where the basis of payment is a Stipulated Sum, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Date)

Bond No. 9468724

Document A312TM - 2010

Conforms with The American Institute of Architects AIA Document 312

Performance Bond

CONTRACTOR:

(Name, legal status and address)

SURETY:

(Name, legal status and principal place of business)

OWNER:

(Name, legal status and address)

Mailing Address for Notices

This document has Important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONSTRUCTION CONTRACT

Date:

Amount: _____

Description:

(Project Name and location)

BOND

Date: _____

(Not earlier than Construction Contract Date)

Amount: _____

Modifications to this Bond: () None () Sec Section 16

CONTRACTOR AS PRINCIPAL

Company: (Corporate Seal)

SURETY

Company: (Corporate Seal)

Signature:

Name

and Title:

Signature:

Name and Title:

(Any additional signatures appear on the last page of this Performance Bond.) (FOR INFORMATION ONLY - Name, address and telephone)

AGENT or BROKER:

OWNER'S REPRESENTATIVE:

(Architect, Engineer or other party:)

§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executor, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

- .1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default.
- .2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
- .3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract.

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors.

§ 5.3 Obtain bids or negotiated proposals from qualified contractors unacceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 6.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

- .1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
- .2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional, written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

- .1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract.
- .2 additional legal, design professional and delay cost-; resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and
- .3 - liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payment made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents with changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.6 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:
Multiple Obligee Rider Attached

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL

Company: (Corporate Seal)

SURETY

Company: (Corporate Seal)

Signature: _____
Name and Title: _____
Address

Signature: _____
Name and Title: _____
Address

MULTIPLE OBLIGEE RIDER

WHEREAS, on or about the _____ day of _____, _____
as Contractor, entered into a written agreement with
, as Oblige e , for

the _____ herein referred to as the Contract; and

WHEREAS, the Contractor, as Principal, and the _____, executed and
delivered to said Contractor their joint and several Performance and Payment Bond; and

WHEREAS, the Oblige e has requested the Contractor and Surety to join with the Oblige e in the execution and delivery of this
Rider, and the Contractor and Surety have agreed so to do upon the conditions herein stated.

NOW, THEREFORE, in consideration of One Dollar and other good and valuable considerations, receipt of which is hereby
acknowledged, the undersigned hereby agree as follows:

The Performance and Payment Bond aforesaid shall be and it is hereby amended as follows :

- I . The name of Allianz Life Insurance Company of North America ISAOA ATIMA: The Huntington National Bank ISAOA
ATIMA: R4 Servicer LLC ISAOA ATIMA: R4 MMOH Acquisition LLC. ISAOA: R4 Capital LLC. ISAOA and Cincinnati
Metropolitan Housing Authority shall be added to said Bond as a Named Oblige e.
2. There shall be no liability on the part of the Principal or Surety under this bond to the Obligees, or any of them, unless
the Obligees, or any of them , shall make payments to the Principal, or to the Surety in case it arranges for completion of
the Contract upon default of the Principal, strictly in accordance with the terms of said Contract as to payments, and
shall perform all the other obligations required to be performed under said Contract at the time and in the manner
therein set forth.
3. Except as herein modified, said Performance and Payment Bond shall be and remain in full force and effect.

SIGNED, sealed and dated this _____ day of _____

WITNESS OR ATTEST:

_____ (Seal)

Principal

By _____

**ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY**

KNOW ALL MEN BY THESE PRESENTS: That the _____, a corporation of the State of _____, the _____, a corporation of the State of _____, and the _____ a corporation of the State of _____ (herein collectively called the "Companies"), by _____, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof; do hereby nominate, constitute, and appoint _____ all of _____, its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: any and all bonds and undertakings, and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the _____ at its office in _____, the regularly elected officers of the _____ at its office in _____, and the regularly elected officers of the _____ at its office in _____, in their own proper persons.

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8 of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said _____, this _____ day of _____, A.D. _____.

ATTEST:

D

By:

By:

On this _____ day of _____, A.D. _____, before the subscriber, a Notary Public of the State of _____, duly commissioned and qualified, _____ of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, depose and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.

Notary Public
My Commission Expires _____

Authenticity of this bond can be confirmed at _____ or _____.

Insert copy of the Bond

Exhibit A

*** Insert a copy of the Drawing Log ***

Exhibit B

*** Insert a copy of the Specification Index***

Exhibit C

*** Insert a copy of the Schedule of Values ***

Exhibit D

*** Insert a copy of the construction schedule ***

Exhibit E

SUPPLEMENTARY CONDITIONS TO THE CONSTRUCTION CONTRACT

U.S. Department of Housing
and Urban Development
Office of Housing

OMB Approval No. 2502-0598
(Exp. 9/30/2021)

Public Reporting Burden for this collection of information is estimated to average 0.2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Response to this request for information is required in order to receive the benefits to be derived. This agency may not collect this information, and you are not required to complete this form unless it displays a currently valid OMB control number. While no assurance of confidentiality is pledged to respondents, HUD generally discloses this data only in response to a Freedom of Information Act request.

Warning: Federal law provides that anyone who knowingly or willfully submits (or causes to submit) a document containing any false, fictitious, misleading, or fraudulent statement/certification or entry may be criminally prosecuted and may incur civil administrative liability. Penalties upon conviction can include a fine and imprisonment, as provided pursuant to applicable law, which includes, but is not limited to, 18 U.S.C. 1001, 1010, 1012; 31 U.S.C. 3729, 3802, 24 C.F.R. Parts 25, 28 and 30, and 2 C.F.R. Parts 180 and 2424.

Article 1: Labor Standards

A. Applicability. The Project or program to which the construction work covered by this Contract pertains is being assisted or insured by the United States of America, and the following Federal Labor Standards Provisions are included in this Contract or related instrument pursuant to the provisions applicable to such Federal assistance or insurance. Any statute or regulation contained herein shall also include any subsequent amendment or successor statute or regulation. The terms of this Supplementary Conditions to the Construction Contract (HUD-92554M) takes precedence over all provisions of the "General Conditions of the Contract for Construction" (AIA Document A201) inconsistent with said Supplementary Conditions.

B. Minimum Wages. Pursuant to Section 212 of the National Housing Act, as amended, 12 U.S.C. 1715c, the minimum wage provisions contained in this paragraph B do not apply to those projects with Security Instruments insured under Section 221(h)(1) designed for less than 9 families and they do not apply to those projects with Security Instruments insured under either Section 220 or 233 designed for less than 12 families.

1. (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the Project) shall be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1 (b)(2) of the Davis-Bacon Act (40 U.S.C. 3141(2)(B)(ii)) on behalf of laborers or mechanics are considered wages paid to such laborers or

mechanics, subject to the provisions of 29 CFR 5.5(a)(1)(iv); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 29 CFR 5.5(a)(1)(ii)) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii) (a) Any class of laborers or mechanics that is not listed in the wage determination and that is to be employed under this Contract shall be classified in conformance with the wage determination. HUD shall approve an additional classification and wage rate and fringe benefits only when the following criteria have been met:

- (1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
- (2) The classification is utilized in the area by the construction industry; and
- (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(b) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and HUD or its designee agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by HUD or its designee to the Administrator of the Wage and Hour Division, U.S. Department of Labor, Washington, D.C. 20210 ("**Administrator**"). The Administrator, or an authorized representative, shall approve, modify, or disapprove every additional classification action within thirty (30) days of receipt and so advise HUD or its designee or shall notify HUD or its designee within the thirty (30) day period that additional time is necessary.

(c) In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives and HUD or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), HUD or its designee shall refer the questions, including the views of all interested parties and the recommendation of HUD or its designee, to the Administrator for determination. The Administrator, or an authorized representative, shall issue a determination within thirty (30) days of receipt and so advise HUD or its

designee or shall notify HUD or its designee within the thirty (30) day period that additional time is necessary.

(d) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs B.1.(ii)(b) or (c) of this Article, shall be paid to all workers performing work in the classification under this Contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the Contract for a class of laborers or mechanics includes a fringe benefit that is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *Provided*, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding. HUD or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the Contractor under this Contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the Contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the Project), all or part of the wages required by the Contract, HUD or its designee may, after written notice to the Contractor, sponsor, applicant, or Owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased. HUD or its designee may, after written notice to the Contractor, disburse such amounts withheld for and on account of the Contractor or subcontractor to the respective employees to whom they are due.

3. Payrolls, records, and certifications.

(i) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the Project). Such records shall contain the name, address, and social security number of each such worker, his or her correct

classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in Section 1 (b)(2)(B) of the Davis-Bacon Act (40 U.S.C. 3141(2)(B)(ii))), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section 1 (b)(2)(B) of the Davis-Bacon Act (40 U.S.C. 3141(2)(B)(ii)), the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(a) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to HUD or its designee if the agency is a party to the Contract, but if the agency is not such a party, the Contractor shall submit the payrolls to the applicant, sponsor, or Owner, as the case may be, for transmission to HUD or its designee. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired, whether paper (Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/whd/forms/wh347.pdf> or its successor site), or electronically pursuant to Program Obligations. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to HUD or its designee if the agency is a party to the Contract, but if the agency is not such a party, the Contractor will submit the payrolls to the applicant sponsor, or Owner, as the case may be, for transmission to HUD or its designee, the Contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this subparagraph for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to HUD or its designee.

(b) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or

supervises the payment of the persons employed under the Contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR 5.5(a)(3)(i), and that such information is correct and complete.

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the Contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the Contract.

(c) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph B.3.(ii)(b) of this Article.

(d) The falsification of any of the above certifications may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Sections 3801 et seq of Title 31 of the United States Code.

(iii) The Contractor or subcontractor shall make the records required under subparagraph B.3.(i) of this Article available for inspection, copying, or transcription by authorized representatives of HUD or its designee or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit the required records or to make them available, HUD or its designee may, after written notice to the Contractor, sponsor, applicant, or Owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and Trainees.

(i) **Apprentices.** Apprentices shall be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship, or with a State Apprenticeship Agency recognized by such Office, or if a person is employed in his or her first ninety (90) days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the

program, but who has been certified by the Office of Apprenticeship, or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where the Contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship, or a State Apprenticeship Agency recognized by such Office, withdraws approval of an apprenticeship program, the Contractor shall no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) **Trainees.** Except as provided in 29 CFR 5.16, trainees shall not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman's hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on

the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor shall no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) **Equal employment opportunity.** The utilization of apprentices, trainees and journeymen under 29 CFR Part 5 shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act Requirements. The Contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this Contract.

6. Subcontracts. The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraphs 1 through 10 of this paragraph B and such other clauses as HUD or its designee may by appropriate instructions require, and a copy of the applicable prevailing wage determination, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all Contract clauses referenced in this subparagraph.

7. Contract termination and debarment. A breach of the Contract clauses in 29 CFR 5.5 may be grounds for termination of the Contract, and for debarment as a contractor or a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this Contract.

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this Contract shall not be subject to the general disputes clause of this Contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and HUD or its designee, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of Eligibility.

(i) By entering into this Contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of Section 3(a) of the Davis-Bacon Act (40 U.S.C. 3144(b)(2)) or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(ii) No part of this Contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of Section 3(a) of the Davis-Bacon Act (40 U.S.C. 3144(b)(2)) or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001. Additionally, U.S. Criminal Code, Section 1010, Title 18, U.S.C., "Federal Housing Administration transactions", provides in part: "Whoever, for the purpose of . . . influencing in any way the action of such Department . . . makes, passes, utters or publishes any statement, knowing the same to be false . . . shall be fined under this title or imprisoned not more than two years, or both."

C. Contract Work Hours and Safety Standards Act.

1. Applicability and Definitions. This paragraph C of Article 1 is applicable only if a direct form of federal assistance is involved, such as Section 8, Section 202/811 Capital Advance, grants etc., and is applicable only where the prime contract is in an amount greater than \$100,000. As used in this paragraph C, the terms "laborers" and "mechanics" include watchmen and guards.

2. Overtime requirements. No contractor or subcontractor contracting for any part of the Contract work that may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty (40) hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty (40) hours in such workweek.

3. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the immediately preceding subparagraph C.2, the Contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, the Contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of such subparagraph, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty (40) hours without payment of the overtime wages required by the clause set forth in such subparagraph.

4. Withholding for unpaid wages and liquidated damages. HUD or its designee shall, upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract, or under any other Federal contract with the same prime contractor, or under any other Federally-assisted contract subject to the Contract Work

Hours and Safety Standards Act which is held by the same prime contractor such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in subparagraph 3 of this paragraph C.

5. **Subcontracts.** The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraphs 1 through 5 of this paragraph C and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in such subparagraphs 1 through 5.

D. Certification.

For projects with Security Instruments insured under the National Housing Act, as amended, that are subject to paragraph B of this Article 1, the Contractor is required to execute the Contractor's Prevailing Wage Certificate within HUD-92448 as a condition precedent to insurance by HUD of the Loan, or an advance thereof, made or to be made by the Lender in connection with the construction of the Project.

Article 2: Equal Employment Opportunity

A. **Applicability.** This Article 2 applies to any contract for construction work, or modification thereof, as defined in the regulations of the Secretary of Labor at 41 CFR Chapter 60, which is paid for in whole or in part with funds obtained from the Federal Government or borrowed on the credit of the Federal Government pursuant to a grant, contract, loan insurance, or guarantee, or undertaken pursuant to any Federal program involving such grant, contract, loan, insurance, or guarantee.

B. The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, disability, or national origin. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, disability or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided setting forth the provisions of this nondiscrimination clause.

C. The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor state that all qualified applicants shall receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, disability, or national origin.

D. The Contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a

notice to be provided advising the said labor union or workers representatives of the Contractor's commitments hereunder, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

E. The Contractor shall comply with all provisions of Executive Order 11246 of September 24, 1965 and of the rules, regulations, and relevant orders of the Secretary of Labor.

F. The Contractor shall furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and shall permit access to its books, records, and accounts by the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

G. In the event of the Contractor's noncompliance with the nondiscrimination clauses of this Contract or with any of the said rules, regulations, or orders, this Contract may be canceled, terminated, or suspended in whole or in part and Contractor may be declared ineligible for further government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulations or order of the Secretary of Labor, or as otherwise provided by law.

H. The Contractor shall include the provisions of paragraphs A through H of this Article 2 in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions shall be binding upon each subcontractor or vendor. The Contractor shall take such action with respect to any subcontract or purchase order as HUD or the Secretary of Labor may direct as a means of enforcing such provisions, including sanctions for noncompliance. *Provided, however,* that in the event the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by HUD or the Secretary of Labor, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

Article 3: Equal Opportunity for Businesses and Lower Income Persons Located Within the Project Area

A. This Article 3 is applicable to projects covered by Section 3, as defined in 24 CFR Part 135.

B. The work to be performed under this Contract is on a project assisted under a program providing Federal financial assistance from HUD and is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u. Section 3 requires that to the greatest extent feasible opportunities for training and employment be given to low and very-low income residents of the unit of local government or the metropolitan area (or non-metropolitan county) as determined by HUD in which the Project is located and contracts for work in connection with the Project be awarded to business concerns which are located in, or owned in substantial part by persons residing in the same metropolitan area (or non-metropolitan county) as the Project.

Article 4: Health and Safety

A. This Article 4 is applicable only where the prime contract is in an amount greater than \$100,000.

B. No laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his or her health and safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation.

C. The Contractor shall comply with all regulations issued by the Secretary of Labor pursuant to 29 CFR Part 1926, and failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act, 40 USC 3701, et seq.

D. The Contractor shall include the provisions of this Article 4 in every subcontract so that such provisions shall be binding on each subcontractor. The Contractor shall take such action with respect to any subcontract as HUD or the Secretary of Labor shall direct as a means of enforcing such provisions.

Exhibit F

Section 3 requirements

Insert project name is subject to the requirements of Section 3. The Parties agree to comply with HUD's regulations in 24 C.F.R. part 75, which implement Section 3 and hereby certify to the best of their knowledge that they are under no contractual or other impediment that would prevent them from compliance. The Authority shall monitor the Contractor's compliance periodically during the Project. The Contractor will, to the greatest extent feasible, meet the benchmarks set by HUD. The Contractor agrees to require all Subcontractors to the greatest extent feasible to comply with Section 3 and the regulations promulgated in 24 C.F.R. part 75, and agrees to take appropriate action upon a finding that the Subcontractor is in violation of the regulations in 24 C.F.R. part 75. The Contractor will not contract with any Subcontractor where the Contractor has notice or knowledge that the Subcontractor has been found in violation of the regulations in 24 C.F.R. part 75.

A. The work to be performed under this contract is subject to the requirements of section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (section 3). The purpose of section 3 is to ensure that employment and other economic opportunities generated by HUD assistance or HUD-assisted projects covered by section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing.

B. The parties to this contract agree to comply with HUD's regulations in 24 CFR part 75, which implement section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the part 75 regulations.

C. The Contractor agrees to send to each labor organization or representative of workers with which the contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the contractor's commitments under this section 3 clause, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notice shall describe the section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s) taking applications for each of the positions; and the anticipated date the work shall begin.

D. The Contractor agrees to include this section 3 clause in every subcontract subject to compliance with regulations in 24 CFR part 75, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this section 3 clause, upon a finding that the subcontractor is in violation of the regulations in 24 CFR part 75. The Contractor will not subcontract with any subcontractor where the contractor has notice or knowledge that the subcontractor has been found in violation of the regulations in 24 CFR part 75.

E. The Contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the Contractor is selected but before the contract is executed, and (2) with persons other than those to whom the regulations of 24 CFR part 75.9 require employment opportunities to be directed, were not filled to circumvent the contractor's obligations under 24 CFR part 75.9.

F. Noncompliance with HUD's regulations in 24 CFR part 75 may result in sanctions, termination of this contract for default, and debarment or suspension from future HUD assisted contracts.

G. With respect to work performed in connection with section 3 covered Indian housing assistance, section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450e) also applies to the work to be performed under this contract. Section 7(b) requires that to the greatest extent feasible (i) preference and opportunities for training and employment shall be given to Indians, and (ii) preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned Economic Enterprises. Parties to this contract that are subject to the provisions of section 3 and section 7(b) agree to comply with section 3 to the maximum extent feasible, but not in derogation of compliance with section 7(b).

Exhibit G

Insert Wage Decision

Exhibit H

SALES TAX ADDENDUM TO

CONSTRUCTION CONTRACT

1. Contractor acknowledges that the Cincinnati Metropolitan Housing Authority (the “Authority”) is the owner, title holder and landlord of certain property in Cincinnati, Ohio located at _____ (the “Improvements”), and _____ LLC (“_____ LLC”), the tenant, plans to develop and rehabilitate the Improvements in connection with the work included in this contract (the “Work”).

2. For state law purposes and pursuant to the Lease Agreement between _____ LLC, as tenant, and Authority, as landlord, Authority is the fee title owner of the Improvements. Because the seventy-five (75)-year term of the Lease Agreement exceeds the expected useful and depreciable life of the Improvements and the benefits and burdens of ownership of the Improvements are transferred to _____ LLC, as tenant, under the terms and conditions of the Lease Agreement, the Improvements are deemed for federal, state and local income tax purposes as owned by _____ LLC under the Lease Agreement.

3. Contractor will indemnify the Authority to the same extent that it indemnifies _____ LLC. With respect to the Work, and solely to the extent necessary to effect such indemnity, Contractor hereby expressly and specifically waives any defenses it may have to the application of or liability under such indemnity by way of Section 35, Article II of the Ohio Constitution and Section 4123.74 of the Ohio Revised Code, as well as any other similar immunity provided for or by any statute, law or constitutional provision of the State of Ohio and of any other applicable state. This covenant shall survive the termination of this contract.

4. Contractor acknowledges that the Authority is not and shall not be obligated to use any money or assets in connection with the Work or to satisfy any duties, obligations, requirements or liabilities whatsoever under this contract. The Contractor irrevocably acknowledges and agrees that it will look solely to _____ LLC for the payment of any additional amounts due or allegedly due under this contract, and that it will not assert or bring any claim against the Authority with respect to any such amounts.

5. Contractor represents and warrants to _____ LLC and Authority that it is and will remain in compliance and, upon request, will provide to _____ LLC appropriate statements or affidavits (and will procure the same from all subcontractors and provide them to _____ LLC) stating that it is in compliance with all legal requirements to be eligible to contract with the Authority, and that it is not aware of any finding for recovery having been issued against it by the Auditor of the State of Ohio which is “unresolved” under Section 9.24, Ohio Revised Code.

6. Contractor shall include the provisions of paragraphs 1 through 4 in all subcontracts that it issues (or contracts for the supply of materials to be used in the Work).

7. Contractor acknowledges that the Authority may be entitled to an Ohio sales and use tax exemption pursuant to Section 5739.02(B) of the Ohio Revised Code for building and construction materials or services incorporated into the real estate being improved by the Work

and the Contractor shall not pay any such Ohio sales or use tax to the extent that exemption is applicable, but only if ____ LLC has provided the Contractor with an appropriate certification (or copy thereof) signed by the Authority, evidencing the availability of such exemption. Contractor shall, and shall require all subcontractors and vendors to, retain copies of all records required under Section 5739.03 of the Ohio Revised Code in connection with the sales or use tax exemption for at least five (5) years after completion of the Work and shall provide those records to the Tax Commissioner of the State of Ohio upon request. This covenant shall survive the termination of this contract.

8. Contractor irrevocably acknowledges and agrees that the Authority has no financial responsibility with respect to the Improvements, and ____ LLC is responsible to pay all costs to construct the Improvements in accordance with the Lease, as defined in the Agreement.

9. Contractor acknowledges that the Authority is a third-party beneficiary to this agreement.

[End of Addendum]

Exhibit I: Unit Delivery and Liquidated Damages

In addition to achieving the Project Substantial Completion Deadline set forth in Article 3.3.2 of the Construction Contract, the Contractor understands, acknowledges and agrees that the Contractor shall also achieve Substantial Completion of its Work under the Contract Documents and delivered to the Owner by Building Floor Phases, which shall consist generally of a set of apartment dwelling units in proximity to each other on the same floor, with each successive Phase being in proximity to the one scheduled for completion immediately prior to it.

The Contractor shall achieve Project Substantial Completion by _____ or _____ days after notice to proceed, whichever is later and Contractor shall achieve Final Completion by _____ or _____ days after notice to proceed, whichever is later.

NTP date:

Phase	Apartments	Construction Completion Calendar Days After Notice to Proceed	Days for GC to finish	Date Units Available for Lease	Equity delivery requirement
1					
2					
3					
4					
5					
6					
7					

Owner to provide the Contractor the following vacant units as each phase progresses: _____ when preceding floor above is turned over for construction to allow for ADA improvements.

The Contractor acknowledges that it will be responsible for the construction of each Phase, as well as the overall planning, coordination and integration of the construction Work requested of the Contractor with respect to each Phase, so that each such Phase and the overall Project is integrated, completed, and coordinated in accordance with the Contract Documents.

The Contractor acknowledges and agrees that timely completion of the Work is the essence of the Contract Documents. Specifically, the Contractor acknowledges that the Owner will incur substantial damages if the dates for Substantial Completion of each Phase of the Work, all as set forth in the table above, and Project Substantial Completion are not met. Among other things, the Contractor acknowledges that in such events the Owner will incur additional financing costs (which in turn will reduce the Owner's equity in the Project), may be required to pay additional amounts to the Architect or other consultants and the Owner's own personnel for assistance on the Project and will suffer actual economic losses in the form of lost rental income and revenues, reduced equity, and operations costs that will not be recoverable by offsetting revenues from the Project's income.

Owner acknowledges the relocation of residents is their responsibility and dates and times set forth above assume Contractor will be provided an entire floor of vacant units. The Owner will work with the Contractor in order to complete the relocation as noted in each phase. Units must be turned over to the Contractor in reasonable condition, vacant, free of belongings and pests/bed bugs. If any units on the floor are not available due to fault of the Owner, Contractor shall provide written notice of unavailability to the Owner within forty eight (48) hours, and if Owner agrees that unavailability is due to fault of the Owner, those days lost plus 1 day will be added onto the phase schedule above.

Because the exact amount of these damages cannot be readily ascertained as of the date of this Contract, and because both the Owner and Contractor desire certainty with respect to their rights and obligations in the event the Project is not completed by the aforementioned date(s), the parties agree that if the Contractor fails to achieve Substantial Completion of each Phase of the Work and/or Final Completion of the entire Work by the dates established therefor, the Contract Sum shall be reduced, as agreed and as liquidated damages, by the following amounts (which shall be cumulative and have been based on a reasonable approximation of the Owner's damages in the event of such failure by Contractor):

(1) Two Hundred Dollars (\$200.00) per calendar day that each Phase of the Work is not Substantially Complete beginning with the date established for Substantial Completion of each such Phase pursuant to table above, and continuing through the earlier of the date Substantial Completion of each such Phase is achieved or thirty (30) calendar days after the date established for Substantial Completion of each such Phase of the Work, but excluding delays attributable to Excused Delays.

(2) One Thousand Dollars (\$1,000.00) per calendar day that each such Phase is not Substantially Complete beginning with the date that is thirty-one (31) calendar days after the date established for Substantial Completion of each such Phase pursuant to above, and continuing through the earlier of the date Substantial Completion of each such Phase is achieved or sixty (60) calendar days after the date established for Substantial Completion of each such Phase of the Work, but excluding delays attributable to Excused Delays.

(3) Two Thousand Dollars (\$2,000.00) per calendar day that each such Phase is not Substantially Complete beginning with the date that is sixty-one (61) calendar days after the date established for Substantial Completion of each such Phase pursuant to above, and continuing through the date Substantial Completion of such Phase is achieved, but excluding delays attributable to Excused Delays.

(4) Five Hundred Dollars (\$500.00) per calendar day for each such day that Project Substantial Completion is not achieved. The lesser of Liquidated Damages or Actual Damages shall be applied, but only with respect to Project Substantial Completion. All delays in achieving Substantial Completion of each Phase set forth in the above table shall be governed by Liquidated Damages set forth above, and not Actual Damages.

LABOR STANDARD PROVISION

All laborers and mechanics employed under this Contract in the construction of the project(s) involved will be paid unconditionally and not less weekly, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act, the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics.

The Contractor shall be fully responsible for the acts or omissions of its subcontractors and of the persons either directly or indirectly employed by them as for the acts or omissions of persons directly employed by Contractor. At all times throughout the Project, the Contractor is fully responsible for assuring each and every subcontractor performing work under this Contract pay its respective laborers and mechanics for such work the full amount of wages and bona fide fringe benefits under the correct prevailing wage rate for the work performed. The Contractor agrees to immediately notify the Owner if the Contractor or any subcontractor has not paid its respective laborers and mechanics for work under this Contract the full amount of wages and bona fide fringe benefits under the correct prevailing wage rate for the work performed. The Contractor further agrees to immediately notify the Owner if Contractor or subcontractor believes a general wage determination issued pursuant to 29 C.F.R. §1.5 is not available for work performed under this Contract. The Contractor shall insert the appropriate clause in all subcontracts to bind subcontractors to the terms and conditions of this contract insofar as they are applicable to the work of subcontractors.

SECTION 000131 – BID FORM ATTACHMENT – LIST OF ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes a list of alternates that are to be included with the Bid Form.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for additional information.

1.2 PROCEDURES

- A. Schedule: See Part 3 – Execution for "Schedule of Alternates" Article included at the end of this Section. Provide cost associated with each alternate on space provided. Provide "Adjusted Total Bid" should all listed Alternates be accepted and incorporated into the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

Alternate No. 1: LVT Flooring

Base Bid: Remove existing VCT and install vinyl flooring over existing concrete floor slab as indicated on demolition drawings and renovation drawings as specified in Section 003126 Existing Hazardous Material Information, Section 024119 Selective Demolition, and Section 096519 Resilient Tile Flooring.

Deduct Alternate: Instead of complete removal of all existing VCT flooring only repair damaged VCT flooring and install new vinyl flooring over existing VCT to remain.

Cost for Alternate: _____

Alternate No. 2: Insulation at Exterior Wall

Base Bid: Metal Studs and Rigid Insulation over Existing Exterior Walls as indicated on Unit Plan Drawings and as specified in Section 072100 Thermal Insulation and Section 092900 Gypsum Board. Include adjustments of outlets, switches, baseboard heating units, etc.

Deduct Alternate: No insulated metal stud construction over Existing Exterior Walls.

Cost for Alternate: _____

Alternate No. 3: Corridor Wall Finish

Base Bid: Install gypsum board (painted) over all exposed CMU surfaces in corridors.
Deduct Alternate: Paint existing CMU walls in corridors.

Cost for Alternate: _____

Alternate No. 4: Apartment (Interior) Doors

Base Bid: Replace all interior apartment doors with solid-core wood doors.
Deduct Alternate: Replace all interior apartment doors with hollow-core wood doors.

Cost for Alternate: _____

Alternate No. 5: Two Additional Parking Spaces

Base Bid: Add pavement for two additional parking spaces as delineated on drawings.
Deduct Alternate: Eliminate work to install two additional parking spaces.

Cost for Alternate: _____

Alternate No. 6: Remove & Replace Concrete Sidewalk South of Parking Lot

Base Bid: Install concrete sidewalk as shown on drawings.
Deduct Alternate: Eliminate work to remove and replace sidewalk.

Cost for Alternate: _____

Alternate No. 7: Concrete Curb Replacement

Base Bid: Install 105 linear feet of concrete curb as delineated on drawings.
Deduct Alternate: Eliminate work to install 105 linear feet of concrete curb.

Cost for Alternate: _____

Alternate No. 8: Interior Door Frames

Base Bid: Replace all interior door frames with hollow metal frames.
Deduct Alternate: Existing door frames to remain as is.

Cost for Alternate: _____

Alternate No. 9: Paint Existing Exterior Surfaces and Exterior Trim

Base Bid: Paint existing exterior surfaces and trim as noted on drawings.
Deduct Alternate: Existing exterior surfaces and trim to remain as is.

Cost for Alternate: _____

Alternate No. 10: Tree Trimming

Base Bid: General tree trimming for all trees on the property.

Deduct Alternate: Eliminate work to trim all trees on the property.

Cost for Alternate: _____

Alternate No. 11: Connecting Sidewalk

Base Bid: Install connecting sidewalk as delineated on drawings.

Deduct Alternate: Eliminate work to install connecting sidewalk.

Cost for Alternate: _____

Alternate No. 12: Apartment Unit Countertops and Window Sills

Base Bid: Solid Surface Countertops and Window Sills as indicated on Drawings and as specified in Section 123661 "Simulated Stone Countertops."

Alternate: Plastic Laminate Countertops and Window Sills as indicated on Drawings and as specified in Section 123623.13 "Plastic-Laminate-Clad Countertops."

Cost for Alternate: _____

Alternate No. 13: Wood Wall Base with Toe Molding

Base Bid: Install painted wood wall base with toe molding.

Alternate: Install 4" coved rubber base.

Cost for Alternate: _____

Adjusted Total Bid: _____

(Includes all Alternates)

END OF SECTION 000131

SECTION 001113 - ADVERTISEMENT FOR BIDS

PART 1 - GENERAL

1.1 PROJECT INFORMATION

- A. Notice to Bidders: Qualified Bidders to submit bids for Project as described in this Document and in accordance with the Instructions to Bidders.
 - 1. Regulatory Requirements: Cincinnati Metropolitan Housing Authority is to govern submittal, opening, and award of bids.
- B. Project Identification: Maple Tower RAD Renovations Project.
 - 1. Project Location: 601 Maple Avenue, Cincinnati, Ohio 45229.
- C. Owner: Cincinnati Metropolitan Housing Authority.
 - 1. Owner's Representative: Michael Koch / Project Manager
michael.koch@cintimha.com
- D. Architect: R.E. Warner & Associates, Inc.
- E. Project Description: Project consists of the general renovation of the existing Maple Tower Apartment Building and site. Finishes and fixtures are to be replaced as noted throughout. Work includes minor layout modifications to the Administration Offices and front entry area. There will be no building additions and no changes to the current occupancy classification. See drawing for other mechanical HVAC, plumbing and electrical Work to be performed.
 - 1. Project cost range is anticipated to be under twelve million dollars (\$12,000,000).
- F. Construction Contract: Bids will be received for the following Work:
 - 1. Multiple-contract Project consisting of the following prime contracts:
 - a. General building construction.
 - b. Plumbing construction.
 - c. Mechanical construction.
 - d. Electrical construction.
 - e. Site/Civil construction.
 - f. Landscaping.

1.2 BID SUBMITTAL AND OPENING

- A. Bid Submittal, Printed: Owner will receive sealed Lump Sum bids until the Bid time and date at the location indicated in the "Invitation for Bids – Schedule and Instructions." Owner will

consider bids prepared in compliance with the Instructions to Bidders.

1.3 BID SECURITY

- A. Submit bid security with each Bid in the stipulated form and in the amount identified in the Instructions to Bidders.
- B. No bids may be withdrawn for a period indicated after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

1.4 PREBID MEETING

- A. Bidders' Questions: Owner will provide responses to Bidders' questions as indicated by the "Invitation for Bids – Schedule and Instructions." Submit requests for clarification and interpretation using method indicated in Instructions to Bidders.
- B. Site Walkthrough Meeting: An "optional" site walk through meeting for all Bidders will be held at Project location as indicated by the "Invitation for Bids – Schedule and Instructions." Prospective prime Bidders are requested to attend.

1.5 BIDDING DOCUMENTS

- A. Bidding Documents, Electronic: Online access will be provided to all registered Bidders and sub-bidders and suppliers.

1.6 TIME OF COMPLETION

- A. By submitting a Bid, Bidder represents that Bidder will begin the Work on receipt of the Notice to Proceed and will complete the Work within the Contract Time indicated in the "Invitation for Bids – Schedule and Instructions."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 001113

SECTION 002600 - PROCUREMENT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids in accordance with Instructions to Bidders.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See the General Conditions and Section 012500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with general intent of the Contract Documents, including level of quality of the Work represented by requirements therein.
 - 3. Request is fully documented and properly submitted.

1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Owner. Procurement Substitution Request must be made in writing by prime contract Bidder only in compliance with the following requirements:

1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
2. Submittal Format, Electronic: Submit Procurement Substitution Request, using format provided on Project web-based bidding management software site.
 - a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and Drawing numbers.
 - b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
 - 1) List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - 2) Product data, including drawings and descriptions of products and fabrication and installation procedures.
 - 3) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
 - 4) Copies of current, independent third-party test data of salient product or system characteristics.
 - 5) Samples where applicable or when requested by Architect.
 - 6) Detailed comparison of significant qualities of proposed substitute with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - 7) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - 8) Research reports, where applicable, evidencing compliance with building code in effect for Project.
 - 9) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate proposed substitute.
 - c. Provide certification by manufacturer that proposed substitute is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to product or equipment specified in the application indicated.
 - d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of substitute to perform as represented in the Procurement Substitution Request.

B. Architect's Action:

1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all Bidders of acceptance of proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

- C. Architect's approval of substitute during bidding does not relieve Contractor of the responsibility to submit required Shop Drawings and to comply with all other requirements of the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 002600

SECTION 003126 - EXISTING HAZARDOUS MATERIAL INFORMATION

PART 1 - GENERAL

1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for the Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. An existing asbestos and lead report for Project, prepared by ECS Midwest, LLC. dated Revised May 8th, 2025, as appended to this Project Manual.
- C. Related Requirements:
 - 1. "Invitation for Bids – Instructions to Bidders for Contracts" for the Bidder's responsibilities for examination of Project site and existing conditions.
 - 2. Section 011000 "Summary" for description of Owner's separate contracts related to abatement of hazardous materials.
 - 3. Section 024119 "Selective Demolition" for notification requirements if materials suspected of containing hazardous materials are encountered.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 003126

SECTION 003143 - PERMIT APPLICATION

PART 1 - GENERAL

1.1 PERMIT APPLICATION INFORMATION

- A. This Document, with its referenced attachments, is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of the Bidders' own investigations. This Document and its attachments are not part of the Contract Documents.
- B. Permit Application: The building permit for Project will be applied for by Owner. A copy of the Permit Application will be on the Project web-based bidding management software site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 003143

SECTION 004373 - PROPOSED SCHEDULE OF VALUES FORM

PART 1 - GENERAL

1.1 BID FORM SUPPLEMENT

- A. A completed Proposed Schedule of Values form is required to be attached to the Bid Form.

1.2 PROPOSED SCHEDULE OF VALUES FORM

- A. Proposed Schedule of Values Form: Provide a breakdown of the bid amount, including Alternates, in enough detail to facilitate continued evaluation of bid. Organize and label contents by section in accordance with the Project Manual table of contents.
 - 1. Provide multiple line items for principal material and subcontract amounts in excess of five percent of the Contract Sum.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 004373

SECTION 006313.13 - REQUEST FOR INTERPRETATION FORM (RFI), BIDDING PHASE

PART 1 - GENERAL

1.1 SUMMARY

- A. Bidders: Utilize this form to request information required for clarifications and interpretations of the Bidding Documents.
- B. Refer to Document "Invitation for Bids – Instructions to Bidders for Contracts" for instructions for submittal of this form and for definitions used on this form.
- C. Response to this request by the Owner/Architect will be in the form of a written Addendum issued to all Bidders. If response to request is not published, use specified product.

1.2 PROJECT INFORMATION

- A. Project Name: Maple Tower RAD Renovations.
- B. Project Location: 601 Maple Avenue, Cincinnati, Ohio 45229.
- C. Owner: Cincinnati Metropolitan Housing Authority.
- D. Owner Solicitation Number: 2025-3010.
- E. Architect: R.E. Warner & Associates, Inc.
- F. Architect Project Number: 07425.

1.3 BIDDING REQUEST INFORMATION

- A. Bidder: _____. Email: _____.
- B. Specification Section No.: _____.
- C. Drawing Sheet/Detail Number: _____.

1.4 INQUIRY

- A. Bidder's Inquiry: _____

B. Signed: _____

C. Date: _____

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 006313.13

DOCUMENT 006313.16 - REQUEST FOR INTERPRETATION FORM (RFI), CONSTRUCTION PHASE

PART 1 - GENERAL

1.1 SUMMARY

- A. Contractor: Utilize this form to request information required by or clarifications of the Contract Documents.
- B. Refer to Section 013100 "Project Management and Coordination" for instructions for submittal of this form and for definitions used on this form.

1.2 PROJECT INFORMATION

- A. Project Name: Maple Tower RAD Renovations.
- B. Project Location: 601 Maple Avenue, Cincinnati, Ohio 45229.
- C. Owner: Cincinnati Metropolitan Housing Authority.
- D. Owner Solicitation Number: 2025-3010.
- E. Architect: R.E. Warner & Associates, Inc.
- F. Architect Project Number: 07425.

1.3 REQUEST INFORMATION

- A. Contractor: _____. Email: _____.
- B. Specification Section and Paragraph No.: _____.
- C. Drawing Sheet/Detail Number: _____.

1.4 INQUIRY

- A. Contractor's Inquiry: _____

_____.
- B. Contractor's Suggested Resolution: _____
_____.

_____.

C. Attachments: _____

_____.

D. Signed: _____

E. Date: _____

1.5 RESPONSE

A. Architect's Response: _____

_____.

B. Signed: _____

C. Date: _____

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 006313.16

SECTION 006325 - REQUEST FOR SUBSTITUTION FORM, CONSTRUCTION PHASE

PART 1 - GENERAL

1.1 SUMMARY

- A. Contractor: Utilize this form to request consideration of an unnamed manufacturer, product, or specified fabrication method prior to commencing submittal preparation when use of specific manufacturers, products, or fabrication methods are required by the specifications.
- B. Refer to Section 012500 "Substitution Procedures" for instructions for submittal of this form and for definitions used on this form.
- C. This form is not required to be submitted when named products are introduced by the phrase "Available products include ..." unless the intended product differs substantially from the requirements of the Contract Documents.
- D. Response to this request by the Owner/Architect will be in the form of a written Modification or other document as described in the Contract Documents.

1.2 PROJECT INFORMATION

- A. Project Name: Maple Tower RAD Renovations.
- B. Project Location: 601 Maple Avenue, Cincinnati, Ohio 45229.
- C. Owner: Cincinnati Metropolitan Housing Authority.
- D. Owner Solicitation Number: 2025-3010.
- E. Architect: R.E. Warner & Associates, Inc.
- F. Architect Project Number: 07425.

1.3 REQUEST INFORMATION

- A. Specification Section and Paragraph No.: _____.
- B. Drawing Sheet/Detail Number: _____.

1.4 REQUEST FOR SUBSTITUTION

- A. Substitution for Cause: Indicate reason for request:

1. ☐ Specified product not available within Project schedule.
2. ☐ Specified product not compatible with other approved products.
3. ☐ Specified warranty not available.
4. ☐ <Insert reason>.

B. Substitution for Convenience:

1. Not allowed.
2. Allowed. Describe proposed benefit to Owner in time and cost:

_____.

1.5 SPECIFIED PRODUCT

- A. Specified Product/Fabrication Method (List name, description, model number, manufacturer):

_____.

- B. Specified Product Information (Note attached):

1.6 PROPOSED PRODUCT

- A. Specified Product/Fabrication Method (List name, description, model number, manufacturer):

_____.

- B. Proposed Product Information (Note required point-by-point comparative data, to be attached to this form):

1. ☐ Point-by-point comparative product data
2. ☐ Test reports
3. ☐ Fabrication drawings
4. ☐ Samples (where applicable)

1.7 IMPACT OF PROPOSED SUBSTITUTION

- A. List of related changes to the Work required by substitution: ☐ None. Explain:

_____.

- B. Differences between specified product and proposed substitution: ☐ None. Explain:

_____.

- C. Proposed product/fabrication method effects on other parts of the Work: ☐ None. Explain:

_____.

- D. Proposed product/fabrication method effects on Contract Time: ☐ None. Explain:

_____.

- E. Proposed product/fabrication method effects on Contract Sum: ☐ None. Explain:

_____.

1.8 CERTIFICATION

- A. Undersigned certifies that:

1. Proposed substitution has been investigated by Contractor who has determined it to be equal or superior to specified product, except as noted herein.
2. Qualifications of manufacturer, installer, and other specified parties meet the specified qualifications.
3. Same warranty will be furnished for proposed substitution as for specified product, if applicable, except as noted herein.
4. Same maintenance service and availability of replacement parts as for specified product, if applicable.
5. Proposed substitution does not affect dimensions and functional clearances, except as noted herein.
6. Proposed substitution will not affect Contract Time, except as noted herein.
7. Proposed substitution will not affect work of other trades, except as noted herein.
8. Proposed substitution provides comparable sustainable design properties as specified product, if applicable.

1.9 SUBMISSION OF REQUEST FOR SUBSTITUTION

- A. For the Contractor:

1. Submittal date: _____.
2. Firm name: _____.
3. Submitted by: _____.
4. Email: _____.

1.10 ARCHITECT'S ACTION

- A. Architect's response to Request for Substitution will be as described in Section 012500 "Substitution Procedures."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 006325

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work performed by Owner.
4. Multiple Work Packages.
5. Work under Owner's separate contracts.
6. Future work not part of this Project.
7. Owner's product purchase contracts.
8. Owner-furnished/Contractor-installed (OFCI) products.
9. Owner-furnished/Owner-installed (OFOI) products.
10. Contractor-furnished/Owner-installed (CFOI) products.
11. Contractor's use of site and premises.
12. Coordination with occupants.
13. Work restrictions.
14. Specification and Drawing conventions.
15. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.2 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.3 PROJECT INFORMATION

- A. Project Identification: Maple Tower RAD Renovations; R.E. Warner project number 07425.
1. Project Location: 601 Maple Avenue, Cincinnati, Ohio 45229.
- B. Owner: Cincinnati Metropolitan Housing Authority.
1. Owner's Representative: Michael Koch; 513.617.3840.

- C. Architect: R.E. Warner & Associates, Inc.; 25000 Country Club Blvd., Suite 340, North Olmsted, Ohio 44070; 440.835.9400.
 - 1. Architect's Representative: Jose Rivera.
- D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:
 - 1. HERS and Sustainability: Emerald Built Environments.
 - a. Sustainability Project Manager: Michael Fodor; 330.807.4161.
- E. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:
 - 1. Landscaping: SWA.
 - a. Landscaping Design Representative: Hank Thomas; 469.677.9872.
- F. Project Coordinator for Multiple Contracts: Owner shall serve as Project coordinator.
- G. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.
 - 1. See Section 013100 "Project Management and Coordination" for requirements for using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
 - 1. The scope of work includes the general renovation of the existing Maple Tower Apartment Building and site. Finishes and fixtures are to be replaced as noted throughout. Work includes minor layout modifications to the Administration Offices and front entry area, and other mechanical, plumbing and electrical Work indicated in the Contract Documents. There will be no building additions and no changes to the current occupancy classification.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.5 WORK PERFORMED BY OWNER

- A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits on Use of Site: Confine construction operations to "scope of Work" areas of the building and coordinate all construction activities with the building Owner to minimize disruption to occupied portions of the building.
 - 2. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.

3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to indicated in the "Invitation for Bids." Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 1. Weekend Hours: Follow "On-Site Work Hours" and limitations.
 2. Early Morning Hours: Follow regulations by authorities having jurisdiction for restrictions on noisy work.
 3. Work in Existing Building: Coordinate any additional restrictions on times permitted with Owner.
 4. Hours for Utility Shutdowns: Coordinate with Owner as required by other sections of the Project Manual.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.
- F. Employee Identification: Owner will provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Procurement and Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
 - 5. Testing and inspecting allowances.
- C. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 014000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.2 DEFINITIONS

- A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect/Engineer from the designated suppliers.

1.4 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form

specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 UNIT-COST ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.9 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by the Owner and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.10 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.

4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump-Sum Allowance: Include the sum of \$5,000.00. Include general tree trimming, as noted on Drawings.
- B. Allowance No. 2: Lump Sum Allowance: Include the sum of \$7,000.00 for storm sewer replacement (underground).
- C. Allowance No. 3: Quantity Allowance: Include cost to repair 15% of total area of gypsum board ceilings.
- D. Allowance No. 4: Quantity Allowance: For Alternate No. 9 "Paint Existing Exterior Surfaces and Trim" include painting 119 linear feet of exterior door trim and 12,750 square feet of exterior surfaces; see drawings for locations.

END OF SECTION 012100

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.
- C. Schedule: See Part 3 – Execution for "Schedule of Alternates" Article included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

Alternate No. 1: LVT Flooring

Base Bid: Remove existing VCT and install vinyl flooring over existing concrete floor slab as indicated on demolition drawings and renovation drawings as specified in Section 003126 Existing Hazardous Material Information, Section 024119 Selective Demolition, and Section 096519 Resilient Tile Flooring.

Deduct Alternate: Instead of complete removal of all existing VCT flooring only repair damaged VCT flooring and install new vinyl flooring over existing VCT to remain.

Alternate No. 2: Insulation at Exterior Wall

Base Bid: Metal Studs and Rigid Insulation over Existing Exterior Walls as indicated on Unit Plan Drawings and as specified in Section 072100 Thermal Insulation and Section 092900 Gypsum Board. Include adjustments of outlets, switches, baseboard heating units, etc.

Deduct Alternate: No insulated metal stud construction over Existing Exterior Walls.

Alternate No. 3: Corridor Wall Finish

Base Bid: Install gypsum board (painted) over all exposed CMU surfaces in corridors.

Deduct Alternate: Paint existing CMU walls in corridors.

Alternate No. 4: Apartment (Interior) Doors

Base Bid: Replace all interior apartment doors with solid-core wood doors.

Deduct Alternate: Replace all interior apartment doors with hollow-core wood doors.

Alternate No. 5: Two Additional Parking Spaces

Base Bid: Add pavement for two additional parking spaces as delineated on drawings.

Deduct Alternate: Eliminate work to install two additional parking spaces.

Alternate No. 6: Remove & Replace Concrete Sidewalk South of Parking Lot

Base Bid: Install concrete sidewalk as shown on drawings.

Deduct Alternate: Eliminate work to remove and replace sidewalk.

Alternate No. 7: Concrete Curb Replacement

Base Bid: Install 105 linear feet of concrete curb as delineated on drawings.

Deduct Alternate: Eliminate work to install 105 linear feet of concrete curb.

Alternate No. 8: Interior Door Frames

Base Bid: Replace all interior door frames with hollow metal frames.

Deduct Alternate: Existing door frames to remain as is.

Alternate No. 9: Paint Existing Exterior Surfaces and Exterior Trim

Base Bid: Paint existing exterior surfaces and trim as noted on drawings.

Deduct Alternate: Existing exterior surfaces and trim to remain as is.

Alternate No. 10: Tree Trimming

Base Bid: General tree trimming for all trees on the property.

Deduct Alternate: Eliminate work to trim all trees on the property.

Alternate No. 11: Connecting Sidewalk

Base Bid: Install connecting sidewalk as delineated on drawings.

Deduct Alternate: Eliminate work to install connecting sidewalk.

Alternate No. 12: Apartment Unit Countertops and Window Sills

Base Bid: Solid Surface Countertops and Window Sills as indicated on Drawings and as specified in Section 123661 "Simulated Stone Countertops."

Alternate: Plastic Laminate Countertops and Window Sills as indicated on Drawings and as specified in Section 123623.13 "Plastic-Laminate-Clad Countertops."

Alternate No. 13: Wood Wall Base with Toe Molding

Base Bid: Install painted wood wall base with toe molding.

Alternate: Install 4" coved rubber base.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. Section 012100 "Allowances" for products selected under an allowance.
 - 3. Section 012300 "Alternates" for products selected under an alternate.
 - 4. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form acceptable to Owner and Architect.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those

of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - h. Research reports evidencing compliance with building code in effect for Project, from OBC.
 - i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Owner of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved

substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 10 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- b. Substitution request is fully documented and properly submitted.
- c. Requested substitution will not adversely affect Contractor's construction schedule.
- d. Requested substitution has received necessary approvals of authorities having jurisdiction.
- e. Requested substitution is compatible with other portions of the Work.
- f. Requested substitution has been coordinated with other portions of the Work.
- g. Requested substitution provides specified warranty.
- h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience:

1. Architect will consider requests for substitution if received within 15 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.

a. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- 1) Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
- 2) Requested substitution does not require extensive revisions to the Contract Documents.
- 3) Requested substitution is consistent with the Contract Documents and will

- produce indicated results.
- 4) Substitution request is fully documented and properly submitted.
 - 5) Requested substitution will not adversely affect Contractor's construction schedule.
 - 6) Requested substitution has received necessary approvals of authorities having jurisdiction.
 - 7) Requested substitution is compatible with other portions of the Work.
 - 8) Requested substitution has been coordinated with other portions of the Work.
 - 9) Requested substitution provides specified warranty.
 - 10) If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue through Owner supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on form included in Project Manual.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Owner will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Owner are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use forms provided by Owner. Sample copies are included in Project Manual.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form provided by Owner. Sample copy is included in Project Manual.

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Contractor will issue a Change Order for signatures of Owner and Contractor on form included in Project Manual.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Owner may issue a Construction Change Directive on form included in Project Manual. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Owner may issue a Work Change Directive on form included in Project Manual. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Document 004373 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
 - 2. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 4. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect through Owner at earliest possible date, but no later than 14 days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.

- c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
5. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
6. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
7. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
8. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
9. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

11. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and Contractor and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.

- b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect through the Owner by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 - 5. Products list (preliminary if not final).
 - 6. Sustainable design action plans, including preliminary project materials cost data.
 - 7. Schedule of unit prices.
 - 8. Submittal schedule (preliminary if not final).
 - 9. List of Contractor's staff assignments.
 - 10. List of Contractor's principal consultants.
 - 11. Copies of building permits.
 - 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 13. Initial progress report.
 - 14. Report of preconstruction conference.

15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 10. Final liquidated damages settlement statement.
 11. Proof that taxes, fees, and similar obligations are paid.
 12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Web-based Project management software package.
 - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
 - 4. Section 019112 "Testing and Verification Plan" for coordinating the Work with Owner's Commissioning Authority.

1.2 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Interpretation. Request from Owner, Construction Manager, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and direction of Project coordinator to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles,

door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Owner will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Owner determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Owner will so inform Contractor, who shall make suitable modifications and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
- C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
 3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
 4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.

7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
- D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using PDF format.
 3. BIM File Incorporation: Construction Manager will incorporate Contractor's coordination drawing files into BIM established for Project.
 - a. Contractor will perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Autodesk's Revit and AutoCAD.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.6 REQUEST FOR INTERPRETATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.
 3. Owner's Project number.

4. Name of Architect.
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's and Owner's Action: Architect and Owner will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect or Owner after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect or Construction Manager of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Owner in writing within 5 days of receipt of the RFI response.

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect and Owner.
 - 4. RFI number, including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's and Owner's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's and Owner's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Owner within three days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.
 - 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
 - 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 - 3. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
 - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.
- B. Web-Based Project Management Software Package: Use Owner's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
 - 1. Web-based Project management software includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between

- project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
 - 2. Provide up to seven Project Management software user licenses for use of Owner, Owner's Commissioning Authority, Owner's Construction Manager, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
 - 3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
 - 4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Autodesk, Inc.
 - b. Deltek Inc.
 - c. Newforma, Inc.
 - d. Procore Technologies, Inc.
 - e. Viewpoint, Inc.; a Trimble Company.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
- 1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Owner's Construction Manager, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Owner's Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Owner's Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Sustainable design requirements.
 - o. Preparation of Record Documents.
 - p. Use of the premises and existing building.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Construction waste management and recycling.
 - x. Parking availability.
 - y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.

- cc. Progress cleaning.
- 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
 - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Owner's Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Owner's Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for completing sustainable design documentation.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Coordination of separate contracts.
 - m. Owner's partial occupancy requirements.
 - n. Installation of Owner's furniture, fixtures, and equipment.
 - o. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Owner's Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
 - 2. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet

- schedule milestones and Contract completion date.
- 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
- 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

- F. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:

- 1. Working electronic copy of schedule file.
- 2. PDF file.

- B. Startup construction schedule.

- 1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

- 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

- E. Construction Schedule Updating Reports: Submit with Applications for Payment.

- F. Daily Construction Reports: Submit at weekly intervals.

- G. Material Location Reports: Submit at weekly intervals.

- H. Site Condition Reports: Submit at time of discovery of differing conditions.

- I. Unusual Event Reports: Submit at time of unusual event.

- J. Qualification Data: For scheduling consultant.

1.4 QUALITY ASSURANCE

1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that is capable of managing construction schedules.
 1. Use scheduling component of Project management software package specified in Section 013100 "Project Management and Coordination," for current Windows operating system.
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
 1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 2. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Commissioning Time: Include no fewer than 15 days for commissioning.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and

as follows in schedule and show how the sequence of the Work is affected.

1. Work under More Than One Contract: Include a separate activity for each contract.
2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Seasonal variations.
 - g. Environmental control.
6. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Temporary enclosure and space conditioning.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.
 - d. Completion of electrical installation.
 - e. Substantial Completion.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion
- F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.

- H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Final Completion percentage for each activity.
- I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- J. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice of Award.
 - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.8 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.

2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Concealed Work photographs.
 - 3. Periodic construction photographs.
 - 4. Final Completion construction photographs.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.2 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in web-based Project management software site:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect and Owner's Construction Manager.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.3 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time from camera.
- D. File Names: Name media files with date Project area and sequential numbering suffix.

1.4 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Construction Manager.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
 - 1. Underground utilities.
 - 2. Underslab services.
 - 3. Piping.
 - 4. Electrical conduit.
- E. Periodic Construction Photographs: Take photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take photographs after date of Substantial

Completion for submission as Project Record Documents. Construction Manager will inform photographer of desired vantage points.

- G. Additional Photographs: Architect or Owner's Construction Manager may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum or in the allowance for construction photographs.
1. Three days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs are to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
8. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Owner Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Owner Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 3. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's and Construction Manager's final release or approval.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Owner and Owner's Construction Manager.
 5. Name of Contractor.
 6. Name of firm or entity that prepared submittal.
 7. Names of subcontractor, manufacturer, and supplier.
 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 9. Category and type of submittal.
 10. Submittal purpose and description.
 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 12. Drawing number and detail references, as appropriate.
 13. Indication of full or partial submittal.
 14. Location(s) where product is to be installed, as appropriate.

15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

- B. Options: Identify options requiring selection by Owner and Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect and Owner's Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect, through Owner's Construction Manager, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

- a. Architect and Owner reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Owner's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Owner's Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's and Construction Manager's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Owner Construction Manager's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.

- e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
- 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
 - 4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site

- to fully identify submittal.
5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
 6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Owner's Construction Manager, will return submittal with options selected.
 8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.

4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
 1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
 5. Product Test Reports: Submit written reports indicating that current product produced

by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM Incorporation: Owner's Construction Manager will incorporate delegated design drawing and data files into BIM established for Project.
 1. Prepare delegated design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Owner's Construction Manager.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform

approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect and Owner's Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S AND OWNER CONSTRUCTION MANAGER'S REVIEW

- A. Action Submittals: Architect and Owner's Construction Manager will review each submittal, indicate corrections or revisions required, and return.
 1. PDF Submittals: Architect and Owner's Construction Manager will indicate, via markup on each submittal, the appropriate action
 2. Submittals by Web-Based Project Management Software: Architect and Owner's Construction Manager will indicate, on Project management software website, the appropriate action.
- B. Informational Submittals: Architect and Owner's Construction Manager will review each submittal and will not return it or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Owner's Construction Manager.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect and Owner's Construction Manager will discard submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 013516 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep an element or detail secure and intact.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
1. Schedule construction operations in sequence required to obtain best Work results.
 2. Coordinate sequence of alteration work activities to accommodate the following:
 - a. Owner's continuing occupancy of portions of existing building.
 - b. Owner's partial occupancy of completed Work.
 - c. Other known work in progress.
 - d. Tests and inspections.
 3. Detail sequence of alteration work, with start and end dates.
 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
 5. Use of elevator and stairs.
 6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns . Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

1.4 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before starting alteration work, conduct conference at Project site.
1. Attendees: In addition to representatives of Owner, Owner's Construction Manager, Architect, and Contractor, testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
 - a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Fire-prevention plan.
 - c. Governing regulations.
 - d. Areas where existing construction is to remain and the required protection.
 - e. Hauling routes.
 - f. Sequence of alteration work operations.

- g. Storage, protection, and accounting for salvaged and specially fabricated items.
 - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - i. Qualifications of personnel assigned to alteration work and assigned duties.
 - j. Requirements for extent and quality of work, tolerances, and required clearances.
 - k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
 - 3. Reporting: Record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at weekly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 - 1. Attendees: In addition to representatives of Owner, Owner's Construction Manager, Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.
 - 2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
 - a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
 - b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:
 - 1) Interface requirements of alteration work with other Project Work.
 - 2) Status of submittals for alteration work.
 - 3) Access to alteration work locations.
 - 4) Effectiveness of fire-prevention plan.
 - 5) Quality and work standards of alteration work.
 - 6) Change Orders for alteration work.
 - 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.5 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.
 - 1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed at Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Alteration Work Subschedule:
 - 1. Submit alteration work subschedule within seven days of date established for commencement of alteration work.
- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- C. Alteration Work Program: Submit 20 days before work begins.
- D. Fire-Prevention Plan: Submit 20 days before work begins.

1.7 QUALITY ASSURANCE

- A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.
 - 1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
- B. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
- C. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs

required in other alteration work Sections.

1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- D. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- E. Safety and Health Standard: Comply with ANSI/ASSP A10.6.

1.8 STORAGE AND HANDLING OF SALVAGED MATERIALS

A. Salvaged Materials:

1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

B. Salvaged Materials for Reinstallation:

1. Repair and clean items for reuse as indicated.
2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Owner, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by

- annotating the identifying marks.
- 2. Secure stored materials to protect from theft.
- 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F or more above the dew point.

E. Storage Space:

- 1. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.

1.9 FIELD CONDITIONS

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of preconstruction photographs and preconstruction videotapes.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
- B. Discrepancies: Notify Owner of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
 - 1. Use only proven protection methods, appropriate to each area and surface being protected.
 - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 - 3. Erect temporary barriers to form and maintain fire-egress routes.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 - 5. Contain dust and debris generated by alteration work and prevent it from reaching the public or adjacent surfaces.
 - 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 - 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 - 8. Provide supplemental sound-control treatment to isolate demolition work from other

areas of the building.

- B. Temporary Protection of Materials to Remain:
 - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
 - 1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 - 3. Maintain existing services unless otherwise indicated; keep in service and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
 - 1. Comply with NFPA 241 requirements unless otherwise indicated.
 - 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
 - 1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
 - 2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
 - 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a

- combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire-watch personnel at each area of Project site until two hours after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs or video recordings. Comply with requirements in Section 013233 "Photographic Documentation."
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Owner of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Owner.

END OF SECTION 013516

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Owner's Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
 - 1. Section 012100 "Allowances" for testing and inspection allowances.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:
 - a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.
- 1.3 DELEGATED DESIGN SERVICES
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect and Owner regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect and Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- E. Reports: Prepare and submit certified written reports and documents as specified.

- F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, telephone number, and email address of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement of whether conditions, products, and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 - 2. Statement that equipment complies with requirements.

3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of

manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor's Responsibilities:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
 - e. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect or Owner's Construction Manager.
 3. Notify Architect and Owner's Construction Manager seven days in advance of dates and times when mockups will be constructed.
 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 6. Obtain Architect's and Owner Construction Manager's approval of mockups before starting corresponding Work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
 8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 2. Payment for these services will be made from testing and inspection allowances specified in Section 012100 "Allowances," as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect, Owner's Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 1. Notify Architect, Owner's Construction Manager, and Contractor promptly of

- irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, Owner's Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections on drawings, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect, Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Construction Manager's and authorities' having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of standards

as listed in building codes.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
 - 1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 - 2. ICC - International Code Council; www.iccsafe.org.
 - 3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
 - 1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
 - 2. DOC - U.S. Department of Commerce; www.commerce.gov.
 - 3. DOD - U.S. Department of Defense; www.defense.gov.
 - 4. DOE - U.S. Department of Energy; www.energy.gov.
 - 5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
 - 6. DOS - U.S. Department of State; www.state.gov.
 - 7. EPA - United States Environmental Protection Agency; www.epa.gov.
 - 8. FAA - Federal Aviation Administration; www.faa.gov.
 - 9. GPO - U.S. Government Publishing Office; www.gpo.gov.
 - 10. GSA - U.S. General Services Administration; www.gsa.gov.
 - 11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
 - 12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
 - 13. NIST - National Institute of Standards and Technology; www.nist.gov.
 - 14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 - 15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 - 16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
 - 17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity

Laboratory; www.ars.usda.gov.

18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from U.S. General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
6. MILSPEC - Military Specifications and Standards; (see DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015639 -TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Temporary Tree and Plant Protection, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Protecting and maintaining existing trees and vegetation to remain not specifically designated for removal.
 - 2. Protection shall be extended to trees and/or vegetation located within or directly adjacent to the Project Site, whether the tree trunk and/or vegetation are located within the designated Limits of Work or not as indicated on the document sheets.
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 312219 "Landscape and Fine Grading"
 - 3. Section 328400 "Landscape Irrigation System"
 - 4. Section 329200 "Turfs, Native Grasses and Wildflowers"
 - 5. Section 329300 "Landscaping"

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. USDA – United States Department of Agriculture.
 - 2. ASTM – American Society for Testing & Materials.
 - 3. ANSI – American National Standards Institute.
 - 4. ISA – International Society of Arboriculture.
- B. Definitions:
 - 1. Tree – A woody perennial plant which usually has (but not limited to) a single dominant trunk and has a mature height of fifteen-feet (15') or more and has a trunk diameter (caliper) of three-inches (3") or more when measured at twelve-inches (12") above the finished grade.
 - 2. Drip-line – The outermost extent of the tree's foliated canopy, which encompasses the tree leaves or fronds, trunk, branches, roots, and soil. In no case shall a drip line

encompass an area under a tree canopy, which is less than ten-feet (10') in diameter. Since each tree is unique in size, scale, and form, the delineated drip-line of each tree shall be refined at the discretion of the Landscape Architect.

3. Injury – Bruising, scarring, tearing, gouging, or breaking of roots, branches, or trunk(s), soil compaction around or within the drip-line, or contamination around the drip-line which results in the decline to the health of the tree.
4. Root Zone– The soil volume surrounding a plant containing the roots.

C. Reference Standards:

1. American National Standard for Tree Care Operation, Tree, Shrub, and Other Woody Plant Maintenance (ANSI A300), American National Standards Institute, Latest Edition.
2. American National Standard for Tree Care Operations (ANSI Z133), American National Standards Institute, Latest Edition.
3. Tree Pruning Guidelines, International Society of Arboriculture, 1995 Edition.
4. Pruning Standards for Shade Trees, National Arborists Association, Latest Edition.

D. Product Data and Sample of fence mesh materials listed in contract documents.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G.

- H. Contractor shall provide site photographs or videotape, sufficiently detailed and described, of existing conditions of trees and vegetation, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing, tree pruning, or tree protection. Submit photographs or videotape to the Landscape Architect prior to commencement of Work.
- I. Preliminary layout of fence protection system shall be laid out with staking on approval by Landscape Architect.
- J. Product Data: Submit complete and legible materials list of items to be provided for Work described herein this Section.
- K. Submit complete detailed schedule and description of Work to be done within drip-line, (if any), including list of equipment to be used.
 - 1. A Certified Arborist may propose pruning of trees or other vegetation not a part of Contractor scope for prevention of tree health decline for approved work occurring within dripline. The Certified Arborist shall have a minimum of five (5) year's post-certification experience performing pruning and observation work for projects of comparable size with trees of similar size and nature.

1.4 QUALITY ASSURANCE AND CONTROL

- A. Pruning and remedial work shall be done under the direct supervision of an Arborist certified by the International Society of Arborists (ISA); or Arborist who is a member in good standing in the American Society of Consulting Arborists, in compliance with ISA and ANSI Standards. Arborist shall be on Site continuously while existing trees or roots are being pruned or remedial work is being performed.

1.5 PRE-INSTALLATION MEETING

- A. Shall not occur without Submittals approved by the Contractor and accepted by the Project Landscape Architect and Owner.
- B. Shall convene a minimum of two weeks before starting work of this section.
- C. Required Attendees:
 - 1. Contractor.
 - 2. Any other subcontractors associated with demolition and tree/vegetation protection Work.
 - 3. Landscape Architect.
 - 4. Owner or Owner's Project Manager or Representative.
 - 5. City entity Building Department Representative or Inspector.
 - 6. Project Arborist, if any.
- D. The Contractor shall make arrangements for the meeting and notify the parties required to attend.

E. Agenda shall include:

1. Review preparation and installation procedures and coordinating and scheduling required with related work.
2. Review protective measures system and detail requirements (drawings, specifications, and other contract documents).
3. Review associated submittals.
4. Review and finalize construction schedule related to site work and verify availability of materials, personnel, equipment and facilities needed to make progress and avoid delays.
5. Review required inspection material usage procedures.
6. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
7. Tour site, inspect and discuss conditions necessary to complete the work of this section.

1.6 PROJECT SITE CONDITIONS

- A. Contractor shall become aquatinted with existing site conditions, verifying quantities and locations of all protected trees and vegetation, and other information as may be necessary. Notify the Landscape Architect of unsatisfactory conditions, in writing, prior to commencement of Work.
- B. Tree Flagging: Prior to commencement of Work, Contractor shall flag existing trees and vegetation to be removed per the plan documents. Adequately flag tree trunks with bright-colored tape (neon colors preferred). Verify flagged trees and vegetation with the Landscape Architect prior to removal or protection device setup. No paint marking of vegetation is allowed.
- C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during tree-pruning or tree-protection operations.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways, if required, by authorities having jurisdiction.
- D. Locate all utilities prior to any Work, and perform Work in a manner which will avoid possible damage. Notify utility locator service for area where Project is located before site clearing where applicable. Notify the Landscape Architect if conflicts exist.
- E. Improvements on Adjoining Property: Authority for performing indicated removal and alteration Work on property adjoining Owner's property shall be obtained by the adjoining property Owner(s) prior to commencement of Work.
- F. Protect existing Work and Work of other trades: Damage to existing construction caused by Work of this Section shall be promptly repaired and/or replaced at the expense of the Contractor.

- G. Environmental Requirements: Perform actual pruning operations (if needed) during those seasons suitable for the specific tree type, in accordance with locally acceptable horticultural practices.

1.7 GUARANTEE

- A. Contractor shall guarantee that plants covered under the Provisions of this Section shall be protected from damage due to construction operations from start of construction until the date of Final Acceptance.
- B. Requirements of the guarantee shall apply if failure of the Contractor to take specified precautions and Work within restrictions of this Section contributes to the destruction, decline, or injury to a tree or plant materials to remain, in the judgment of the Landscape Architect.
- C. If a tree designated to be protected accordingly is destroyed or injured so that in the judgment of the Landscape Architect or third-party reviewer, it should be replaced, it shall be removed at the expense of the Contractor. Contractor shall pay compensation to the Owner where the tree or plant material was located at the rate as specified herein this Section (see Compensation).

1.8 COMPENSATION

- A. Contractor shall replace existing plant material designated to remain that dies or sustained injury from the result of the Contractor's negligence to provide adequate required protection, pruning, or maintenance during the course of construction operations. Replacement shall equate or match material removed
- B. Trees: Contractor shall thoroughly remove damaged tree, including trunk, branches, and roots, at no cost to the Owner or Owner, and at the direction of the Landscape Architect.
 - 1. Contractor shall furnish and install per requirements in Section 329300 "Trees, Shrubs, Vines and Groundcovers", with an equal size tree (in height, spread, and caliper), and of the same form, species, and in the same quantity as those tree(s) that were damaged, at the direction of the Landscape Architect. Compensation shall include the actual cost of the item prepared for procurement; transportation or delivery of boxed item to the site; unloading, planting and staking; maintenance, including watering, fertilizing, pruning, pest control, and other care to bring replacement to same general condition of the original item. Maintenance terms shall be substantial completion or one calendar year from date of acceptance.
- C. Other Plant Material (other than Trees): Contractor shall replace other vegetation (other than trees) that died or sustained injury from the result of the Contractor's negligence to provide adequate required vegetation protection, pruning, or maintenance during the course of construction operations. Compensation shall be awarded to the Owner as follows:

1. Contractor shall thoroughly remove damaged vegetation at no cost to the Owner or Owner, and at the direction of the Landscape Architect.
2. Contractor shall furnish and install per requirements in Section 329300 – Trees, Shrubs, Vines and Groundcovers, with equal size plant material as those which were damaged (as applicable) of the same form, species, and in the same quantity as vegetation that was damaged, at the direction of the Landscape Architect.

PART 2 - PRODUCTS

2.1 TREE PROTECTION MATERIALS

- A. Temporary Barricade for Protection of Existing Vegetation (for temporary uses only):
 1. Fabric: Utility (snow) type fencing, minimum four-feet (4'-0") high, consisting of a vinyl meshed fabric, extended in a bright orange color and approved by the Landscape Architect.
 2. Posts: Metal sufficient in gauge (as appropriate) and size to support the fabric material in a taut and plumb condition. Posts shall be subject to approval by the Landscape Architect. Refer to contract documents.
 3. Wire- 12-1/2 gauge Shaffield wire, spaced per drawings
- B. Chain Link Fencing:
 1. 6' fencing, 2" square galvanized chain link with galvanized posts and continuous tension wire, top and bottom. Minimum wire size 14 gauge galvanized. Set 2" diameter posts in soil with adequate size and embedment for support through construction. Provide terminal and anchor posts for support at size and frequency required. Provide stantions for 2" posts where required on hardscape surfaces.
- C. Mulch: Where available, Contractor shall stockpile and reuse shredded wood chips produced from on-site tree removals and remedial work, if chips are disease free and acceptable to the Landscape Architect. Where on-site chips are not available, Contractor shall provide Shredded Wood Mulch as specified in Section 329400 – Landscape Planting Accessories.
- D. Screening Fabric: Woven polyethylene product with min 80% density to 100% for visual impeding however with wind allowance. All edges shall be hemmed and tie-ins shall be grommeted. Dark Green in color. Minimum one (1) year warranty on product.

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

3.2 PREPARATION

- A. Provide erosion-control measures as needed to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
 - 1. Standard State of Texas Environmental Regulations apply including all Stormwater Pollution Prevention measures for site over five (5) acres.
 - 2. Standard County of Bastrop Environmental Regulations apply. Refer to City for requirements.
- B. Locate and clearly flag trees and vegetation to be removed or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
- D.

3.3 TREE AND VEGETATION PROTECTION

- A. Protect existing trees and other vegetation indicated to remain in place against the following:
 - 1. Storage or parking of automobiles or other vehicles.
 - 2. Stockpiling of building materials, refuse, or excavated materials.
 - 3. Use of trees as support posts, power posts, or sign posts, anchorage for ropes, guy wires, or power lines, or other similar functions.
 - 4. Dumping of poisonous materials on or around plant roots, trunks, branches, or foliage. Such materials include, but are not limited to, paint, petroleum products, dirty water, or other deleterious materials.
 - 5. Cutting, breaking, or skinning of roots caused by utility trenching, foundation digging, placement of curbs and trenches, and other miscellaneous excavation without prior written approval by the Landscape Architect.
 - 6. Damage by skinning or bruising of bark on trunks or branches, caused by maneuvering vehicles or stacking material or equipment too close to the plant.
 - 7. Compaction of the soil within the drip-line of the plants due to movement of trucks or grading machines, pedestrian or vehicular traffic, storage of equipment or materials.
 - 8. Excessive water or heat from equipment or utility line construction.
 - 9. Damage to root system from flooding, erosion, and excessive wetting and drying resulting from watering and other operations.
- B. Prior to commencement of construction activities, the Contractor shall erect and maintain a temporary fenced (chain link) barricade around the drip-line of individual trees, around perimeter drip-line of groups of trees, or around other vegetation to remain at distance specified in contract drawings or approved by Landscape Architect.
 - 1. Prevent damage to roots during installation of barricade posts. Space posts approximately 6'-0" on-center (O.C.) and securely attach fabric.
 - 2. Barricades top wire shall be installed plumb, taut, and sturdy to prevent unauthorized access around drip-line of trees and protected vegetation. Repair sagging or damaged barricades immediately.

3. During the course of construction, relocation of the barricade may be required to facilitate construction. Contractor shall relocate barricade as directed by the Landscape Architect at no additional expense to the Owner.
 4. Remove barricade when construction operations are complete or when directed by the Landscape Architect.
- C. Irrigation: Contractor shall supply fresh potable water in adequate amounts and rates of application as required to maintain the health of protected plant material throughout the duration of the construction operations. Contractor shall maintain a watering schedule and document dates and duration of irrigation applications.
1. Provide supplemental watering and dust control as needed and requested by arborist or Landscape Architect review at no additional cost to the owner.
- D. Do not excavate within drip line of trees, unless approved, in writing, by the Landscape Architect.
- E. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
1. Cover exposed roots with burlap and water regularly.
 2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
 3. Coat cut faces of roots more than 1-1/2 inches in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
 4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.
- F. Protect root systems of existing trees and vegetation from damage due to chemically injurious materials in solution caused by run-off or spillage during mixing or placement of construction materials, and drainage of stored materials.
- G. Protect root systems from flooding, erosion, excessive wetting or drying resulting from de-watering or other operations.
- H. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by the Landscape Architect.
1. Employ a qualified arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
 2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified Arborist.
- 3.4 PRUNING AND REMEDIAL WORK
- A. Pruning and remedial work shall be done under continuous supervision of the approved Arborist, according to approved submittals, and per ANSI A300 Pruning Standards.

- B. Provide pruning, cabling and bracing, irrigation, pest and disease control and other remedial treatments as recommended by the approved Arborist, required to assure the long-term health of the trees and existing vegetation, and the safety of persons and property.
- C. Salvage trees 18" diameter and smaller for shredding of wood material to mulch. Mulch to be used on site for tree protection and temporary access.

3.5 MAINTENANCE

- A. Keep areas within tree protection barricades free from weeds, trash, and debris. Do not use herbicides.
- B. Maintain mulch layer and protective devices throughout entire period of construction.

END OF SECTION 015639

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 012100 "Allowances" for products selected under an allowance.
 - 3. Section 012300 "Alternates" for products selected under an alternate.
 - 4. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 5. Section 014200 "References" for applicable industry standards for products specified.
 - 6. Section 017700 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluating Comparable Products: In addition to the basis-of-design product description,

product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in "Comparable Products" Article.
- E. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Resolution of Compatibility Disputes between Multiple Contractors:
 - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Owner will determine which products will be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is inconspicuous.

2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 2. Store products to allow for inspection and measurement of quantity or counting of units.
 3. Store materials in a manner that will not endanger Project structure.
 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.

5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections are to be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Owner will make selection.
5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect through Owner's Construction Manager in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by Architect, whose determination is final.
7. Buy America: Wherever possible product selection should meet the requirements of the BaBa, Build America Buy America Act unless noted otherwise by direction from CMHA.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for a comparable product. Architect will notify Contractor through Owner's Construction Manager of approval or rejection of proposed comparable product within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
1. Architect's Approval of Submittal: Marked with approval notation from Architect's action stamp. See Section 013300 "Submittal Procedures."
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering.
 - 3. Installation.
 - 4. Cutting and patching.
 - 5. Coordination of Owner's portion of the Work.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for coordination of Owner-performed work, and limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect and Owner's Construction Manager of

scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

- a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Owner of locations and details of cutting and await directions from

- Owner before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Owner's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect through Owner's Construction Manager in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- B. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Owner's Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Owner's Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with

indicated requirements.

- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Owner. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or

adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
 - 1. Provide temporary facilities required for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials for more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the

entire work area, as appropriate.

- D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019112 "Testing and Verification Plan."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this Section includes administrative and procedural requirements for the following:
 - 1. Recycling non-hazardous demolition and construction waste.
 - 2. Disposing of non-hazardous demolition and construction waste.

1.2 DEFINITIONS

- A. CMU: Concrete masonry units.
- B. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- C. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- D. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- E. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for the Notice of Award. Plan must include the following:
 - 1. Strategies to reduce the generation of waste during Project design and construction.
 - 2. Waste diversion goals for Project, identifying the materials (both structural and nonstructural) targeted for recycling, reuse, or salvage and identifying the target

diversion percentage (at least 50 percent).

3. Where materials will be taken, including expected diversion rates for each material.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:
 1. Material category.
 2. Generation point of waste.
 3. Total quantity of waste in tons.
 4. Quantity of waste recycled, both estimated and actual in tons.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- E. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Qualification Statements: For waste management coordinator.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.
- B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.

2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan in accordance with requirements in this Section. Plan must include provisions for waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 1. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 2. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 4. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there were no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste reduction work plan and Form CWM-6 for demolition waste reduction work plan. Include the following:
 1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include transportation and tipping fees and cost of collection containers and handling for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in transportation and tipping fees by donating materials.
 7. Savings in transportation and tipping fees that are avoided.

8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS

2.1 RECYCLING RECEIVERS AND PROCESSORS

- A. Subject to compliance with requirements, use available recycling receivers and processors acceptable to the Owner and Authority Having Jurisdiction.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:
 - a. Asphalt paving.
 - b. Concrete.
 - c. Concrete reinforcing steel.
 - d. Brick.
 - e. CMU.
 - f. Wood studs.
 - g. Wood joists.
 - h. Plywood and oriented strand board.
 - i. Wood paneling.
 - j. Wood trim.
 - k. Structural and miscellaneous steel.
 - l. Rough hardware.
 - m. Insulation.
 - n. Doors and frames.
 - o. Door hardware.
 - p. Glazing.
 - q. Metal studs.
 - r. Gypsum board.
 - s. Acoustical tile and panels.
 - t. Carpet.
 - u. Carpet pad.
 - v. Equipment.
 - w. Cabinets.
 - x. Plumbing fixtures.

- y. Mechanical equipment.
- z. Electrical conduit.
- aa. Copper wiring.
- bb. Lighting fixtures.
- cc. Lamps.
- dd. Ballasts.
- ee. Electrical devices.
- ff. Transformers.

2. Construction Waste:

- a. Masonry and CMU.
- b. Lumber.
- c. Wood sheet materials.
- d. Wood trim.
- e. Metals.
- f. Insulation.
- g. Carpet and pad.
- h. Gypsum board.
- i. Piping.
- j. Electrical conduit.
- k. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Wood pallets.
 - 8) Plastic pails.
- l. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
 - 1) Paper.
 - 2) Aluminum cans.
 - 3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator must be present at Project site full time for duration of Project.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
- B. Salvaged Items for Sale or Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use: Handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials to accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials in accordance with recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to maximum extent practical in accordance with approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Wood Materials: Sort and stack members per size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- B. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members per size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

- C. Gypsum Board: Stack large clean pieces on wood pallets or in containers and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- D. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- E. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- F. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- G. Carpet Tile: Remove debris, trash, and adhesive.
 - 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- H. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- I. Conduit: Reduce conduit to straight lengths and store by material and size.
- J. Lamps: Separate lamps by type and store in accordance with requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cutoffs of Lumber: Grind or chip into small pieces.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in containers and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

- a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.
- D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

- A. Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Unless otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning:
 - 1. Do not burn waste materials.

3.7 ATTACHMENTS

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-2 for demolition waste identification.
- C. Form CWM-3 for construction waste reduction work plan.
- D. Form CWM-4 for demolition waste reduction work plan.
- E. Form CWM-5 for cost/revenue analysis of construction waste reduction work plan.
- F. Form CWM-6 for cost/revenue analysis of demolition waste reduction work plan.
- G. Form CWM-7 for construction waste reduction progress report.
- H. Form CWM-8 for demolition waste reduction progress report.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final Completion procedures.
 - 3. List of incomplete items.
 - 4. Submittal of Project warranties.
 - 5. Final cleaning.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
 - 3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 5. Section 017900 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit sustainable design submittals not previously submitted.
 - 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection

or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect and Owner's Construction Manager.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF Electronic File: Architect, through Owner's Construction Manager, will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Owner for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect and Owner.
- E. Warranties in Paper Form:
1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.

- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
 - h. Vacuum and mop concrete.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - q. Clean strainers.
 - r. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 CORRECTION OF THE WORK

- A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 019112 "Testing and Verification Plan" for verification and compilation of data into operation and maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Owner and Architect. Enable reviewer comments on draft submittals.

- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual.

Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual to contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Owner's Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation in accordance with ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 - 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 - 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 - 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.7 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Gas leak.
 - 4. Water leak.
 - 5. Power failure.
 - 6. Water outage.
 - 7. System, subsystem, or equipment failure.
 - 8. Chemical release or spill.

- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.

7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the

relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
 - 2) Owner will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories and paper copies of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Work Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
 4. Architect will furnish Owner with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Owner's Construction Manager.
 - e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
1. Give particular attention to information on concealed products and installations that

- cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

- B. Format: Submit record specifications as annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file.
1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Owner's Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.

2. Transcript:
 - a. Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 - b. Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:

- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and

training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Owner's Construction Manager, with at least 14 days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

SECTION 018113 – SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 PROJECT GOALS

- A. This project has been designed to comply with the Enterprise Green Communities Manual v2020 criteria as indicated.
- B. Many of the sustainable design credits can be achieved only through intelligent design of the project and are beyond the control of the Contractor. However, certain credits relate to the products and procedures used for construction. Therefore, the full cooperation of the Contractor and subcontractors is essential to achieving final certification.
- C. Contractor shall familiarize himself with the relevant requirements and provide the necessary information and instruction to all subcontractors and installers.
- D. Since Contractor and subcontractors may not be familiar with sustainable design requirements, this section includes a summary of the products and procedures intended to achieve sustainable design credits.
 - 1. Some credits are dependent on proper performance by Contractor and subcontractors.
 - 2. Other credits involved quantifying percentages by weight or volume and cost; these require careful recordkeeping and reporting by the Contractor.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Other Standards/Guidelines applicable to project:
 - 1. 2020 Enterprise Green Communities Criteria Manual
 - 2. 2020 Enterprise Green Communities Project Workbook

1.3 SUMMARY

- A. Section includes:
 - 1. Summary of sustainable building requirements for project as necessary to meet the 2020 Criteria of Enterprise Green Communities (EGC).
 - 2. Related performance and administrative requirements.
 - 3. A copy of EGC checklist is attached at the end of this Section for information only.
 - a. Some requirements depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.

B. Related Sections:

1. Section 019112 "Testing and Verification Plan"
2. Divisions 02 through 12, 14, 22, 23, 26, 28, 31 through 33 where related submittal, product, or execution requirements relate to Criteria. Requirements are not repeated but 018113 is referenced within respective sections.

1.4 COORDINATION

- A. Contractor is responsible for all requirements of the EGC 2020 Criteria that are contained throughout these Specifications, including successful compliance with and passage of visual inspections and performance tests by verifying party.
- B. ENERGY STAR verification: Contractor is responsible for coordinating with appropriate verification team members to ensure inspections and leakage tests can be performed at the appropriate times and without delaying construction progress.
1. Coordinate framers, plumbers, HVAC, insulators, and drywall trades to minimize uncontrolled air leakage pathways between residential units by sealing all penetrations in walls, ceilings, and floors in the units and by sealing all vertical chases adjacent to the units.
 2. Comply with and provide labor as necessary to facilitate compliance with applicable ENERGY STAR program requirements. Contractor and all relevant project team members to adhere to T&V Protocol responsibility matrix. The responsibility matrix defines which parties have roles and documentation requirements for each section within the T&V protocols. Each noted party is responsible for understanding the specific requirements as noted in the T&V protocols document.

1.5 SUBMITTALS

- A. General: Submit additional sustainable design requirements required by other Specification Sections.
- B. Sustainable design submittals are in addition to other submittals.
1. If submitted item is identical to that submitted to comply with other requirements, include an additional copy with other submittal as a record copy of compliance with indicated EGC requirements listed instead of separate sustainable design submittal. Mark additional copy "Sustainable design submittal."
- C. Site Improvement Submittals:
1. 3.1 Environmental Remediation:
 - a. Submit Phase I Environmental Site Assessment, Tier II Environmental Review Assessment, environmental site assessment approved by HUD through the Part 50 or Part 58 process, an environmental assessment approved by USDA through the 1940-G or 1794 process.

2. 3.2 Minimization of Disturbance During Staging and Construction:
 - a. Submit photo documentation of erosion control measures throughout construction
 3. 3.3 Ecosystem Services/Landscape:
 - a. Submit product data for plantings indicating only native or adaptive species.
 4. 3.4 Surface Stormwater Management
 - a. Submit documentation indicating that the project was designed to treat or retain on-site precipitation equal to the 60th percentile precipitation event or maximum volume possible (if land disturbed is greater than or equal to 5,000 sq. ft.).
 5. 3.6 Efficient Irrigation and Water Reuse:
 - a. Confirm no irrigation OR submit documentation indicating efficient irrigation (verify type: zoned, drip, timer/controlled or moisture sensor)
- D. Water Conservation Submittals:
1. 4.1 Water-Conserving Fixtures:
 - a. Submit product data for toilets and urinals documenting flush rate in gallons per flush (gpf); for showerheads, kitchen and lavatory faucets, documenting flow rate in gallons per minute (gpm). Confirm fixtures result in at least 20% reduction from baseline levels as indicated in EGC 2020 reference guide.
 - b. Submit product data for toilets, urinals, showerheads, and lavatory faucets documenting fixture is WaterSense-labeled.
- E. Energy Efficiency Submittals
1. 5.1b Building Performance Standard:
 - a. Multifamily buildings where each dwelling unit has its own heating, cooling, and hot water system.
 2. 5.6 Sizing of Heating and Cooling Equipment:
 - a. Submit heating and cooling load calculations and equipment selection performed in accordance with Air Conditioning Contractors of America (ACCA) Manuals J and S or ASHRAE handbooks.
 3. 5.7 ENERGY STAR Appliances:
 - a. If providing appliances, submit clothes washer, dishwasher, and refrigerator product details generated directly from ENERGY STAR's list of certified products.
 4. 5.8 Lighting:
 - a. Submit product data for all lighting fixtures, lighting, and lamps documenting efficacy in lumens per watt (lm/W)
 - b. Submit product data for all lighting controls.
- F. Materials Submittals:
1. 6.4 Healthier Material Selection:
 - a. Submit for all interior paints, coatings, primers, and wallpaper:
 - 1) Product cutsheet
 - 2) VOC content
 - 3) VOC emissions verified as compliant with CDPH Standard Method for all wall finish products

- 4) Confirmation the wallpaper is phthalate free
 - b. Submit for all interior adhesives and sealants:
 - 1) Product cutsheet
 - 2) VOC content
 - c. Submit for all flooring:
 - 1) Product cutsheet
 - 2) CDPH emission confirmation
 - d. Submit for all insulation:
 - 1) Product cutsheet
 - 2) Confirmation that fiberglass or mineral wool batts are formaldehyde-free
 - e. Submit for all composite wood:
 - 1) Formaldehyde emissions less than or equal to the thresholds provided by CARB Phase 2 and/or TSCA Title IV for plywood, particleboard, MDF, and these materials within other products like cabinets and doors. For any other composite wood products not covered by CARB/TSCA requirements, but used in interior spaces, these must at minimum be NAUF (have no added urea formaldehyde).
- 2. 6.6 Mold Prevention: Tub & Shower Enclosures:
 - a. Submit product documentation demonstrating all drywall behind tub and shower enclosures meets ASTM# D 6329 or 3273.
- 3. 6.10 Construction Waste Management:
 - a. Submit a waste management plan including one of the following options:
 - 1) Divert at least 75% of all construction waste from landfill
 - 2) Divert 100% from landfill of at least two waste streams. Choose from the following:
 - a) Recycle all cardboard
 - b) Recycle all wood
 - c) Recycle all drywall
 - d) Recycle all metals
 - e) Recycle all concrete, brick and asphalt
 - f) Develop, implement, and document a comprehensive efficient framing plan that minimizes waste by design
 - b. Submit waste disposal reports at specified intervals indicating quantities of trash and waste in tons or cubic yards. Show totals to date.

G. Healthy Living Environment Submittals:

- 1. 7.5 Integrated Pest Management:
 - a. Submit product data for nontoxic sealing methods including window screens, door sweeps, escutcheon plates, and rodent- and corrosion-proof screens for openings greater than ¼ inch.
- 2. 7.7 Ventilation:
 - a. Submit product data for in-unit ventilation system(s) in compliance with ASHRAE 62.2-2010 requirements for:
 - 1) Local mechanical exhaust systems in bathrooms;
 - 2) Local mechanical exhaust systems in kitchens; and
 - 3) Whole-house mechanical ventilation.
 - b. Submit product data for any individual bathroom fans demonstrating ENERGY

- STAR label and humidistat sensor, timer, or other control.
- c. Submit product data for any central ventilation systems in compliance with ASHRAE 62.1-2010 requirements for any corridors, stair wells, common and amenity areas and retail/commercial/office spaces.
- d. Submit product data for any central rooftop fans showing direct-drive and variable speed capability.
- e. Submit product data for any fan providing central ventilation with design CFM 300-2000 showing an electronically commutated motor (ECM).

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Sustainable Design coordinator.
- B. Action Plans: Submit the following action plans within 14 days of date established for the Notice to Proceed, indicating how requirements will be met.
 - 1. Waste management plan complying with EGC requirements
 - 2. Material Emissions and Pollutant Control Plan: List of proposed products. Indicate each product that complies with criteria, each product that does not, and anticipated quantities of each that will be used. Include calculations showing that percentage of noncompliant products will not exceed allowable limit.
 - 3. Construction IAQ management plan.
- C. Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction with action plans.

1.7 QUALITY ASSURANCE

- A. Sustainable Design Coordinator: Engage an experienced coordinator to coordinate EGC requirements. Sustainable Design coordinator may also serve as waste management coordinator.
 - 1. Sustainable Design Coordinator shall have previously coordinated at least one sustainable project.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle building materials made of organic material or those that could absorb moisture to prevent deterioration or damage due to moisture, temperature changes, contaminants, or corrosion, and to prevent collecting organic matter such as leaves, soil, or insects.
- B. Do not deliver or install materials made of organic material or those that could absorb moisture until painting and similar operations that could damage them have been completed in installation areas

- C. Do not install interior walls, wood floors, ceilings, or HVAC systems until the building envelope is weathertight and has been permitted to dry.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Site Improvements:

- 1. 3.3 Ecosystem Services/Landscape:
 - a. All trees, shrubs, groundcover, grasses, and plantings must be native or adapted to the region.
 - b. All new plants must be appropriate to the site's soil and microclimate, and none should be invasive species.
- 2. 3.6 Efficient Irrigation and Water Reuse:
 - a. Timer/Controller must be capable of activating a valve for each watering zone at the best time of day to minimize evaporative losses while maintaining healthy plants and obeying local regulations and water-use guidelines.

B. Water Conservation:

- 1. 4.1 Water-Conserving Fixtures:
 - a. Toilets, WaterSense-labeled and ≤ 1.28 gallons per flush (gpf).
 - b. Urinals, WaterSense-labeled and ≤ 0.5 gpf.
 - c. Showerheads, WaterSense-labeled and ≤ 2.0 gallons per minute (gpm).
 - d. Kitchen faucets, ≤ 2.0 gallons per minute (gpm).
 - e. Lavatory faucets, WaterSense-labeled and ≤ 1.5 gallons per minute (gpm).

C. Energy Efficiency:

- 1. 5.1b Building Performance Standard: Multifamily buildings where each dwelling unit has its own heating, cooling, and hot water system.
 - a. Provide products that meet ENERGY STAR program requirements.
- 2. 5.6 Sizing of Heating and Cooling Systems:
 - a. Install equipment that meets the sizing calculations in accordance with the Air Conditioning Contractors of America (ACCA) Manuals J and S or ASHRAE handbooks. Equipment capacity shall not exceed calculated sizing by more than 20% (unless smaller capacity equipment is unavailable).
- 3. 5.7 ENERGY STAR Appliances:
 - a. The following appliances shall be ENERGY STAR certified:
 - 1) Clothes washers; and
 - 2) Dishwashers; and
 - 3) Refrigerators
- 4. 5.8 Lighting:
 - a. Permanently installed lighting fixtures shall be high-efficiency lighting that is capable of meeting recommended light levels (weighted average footcandle) in the Illuminating Engineering Society Lighting Handbook, 10th edition.

- b. Recessed light fixtures installed as part of a building or dwelling unit air barrier shall be Insulation Contact Air-Tight (ICAT); exempt if installed entirely inside of or outside of an air barrier.
- c. Lighting inside the building, but not in a dwelling unit, shall be controlled by occupancy sensors or automatic bi-level lighting controls; exempt if 24-hour consistent light levels are required by code.
- d. Lighting power density in dwelling units, measured in watts/square foot, is 1.1 or less.
- e. All exterior lighting shall meet the following specifications and have either motion sensor controls, integrative PV cells, photosensors, or astronomic time-clock operation to limit lighting when there is adequate daylight. Note, Dark Sky–approved “Friendly Fixture” certification automatically meets the following requirements:
 - 1) Luminaires shall be fully shielded emitting no light above 90 degrees (with the exclusion of incidental light reflecting from fixture housing, mounts, and pole). The luminaire’s mounting hardware shall not permit mounting in any configuration other than those maintaining full shielding. Non-residential luminaires shall have an uplight rating of U0.
 - 2) Fixture shall have no sag or drop lenses, side light panels or uplight panels.
 - 3) Fixture shall employ warm-toned (3000K and lower) white light sources or may employ amber light sources or filtered LED light sources.

D. Materials:

- 1. 6.4 Healthier Material Selection: Products must comply with the following:
 - a. All interior paints, coatings, primers, and wallpaper:
 - 1) VOC content less than or equal to the thresholds provided by the most recent version of SCAQMD 1113 available at time of product specification for all interior paints, coatings and primers.
 - 2) VOC emissions verified as compliant with CDPH Standard Method for all wall finish paints.
 - 3) All wallpaper, phthalate free
 - b. All interior adhesives and sealants
 - 1) VOC content less than or equal to the thresholds provided by the most recent version of SCAQMD 1168 available at time of product specification for all interior adhesives and sealants.
 - c. Flooring
 - 1) All flooring products (whether carpet or hard surface) must comply with CDPH emission requirements.
 - 2) No flexible PVC with phthalates may be installed, whether the phthalates were intentionally added or added via recycled content.
 - 3) No carpet in the project may be installed in building entryways, laundry rooms, bathrooms, kitchens/kitchenettes, or utility rooms.
 - 4) Fluid applied finish floors may only be installed in non-occupied spaces, such as mechanical rooms.
 - d. Insulation
 - 1) If fiberglass or mineral wool batts are used, these must be formaldehyde-free.

- e. Composite Wood
 - 1) Formaldehyde emissions less than or equal to the thresholds provided by CARB Phase 2 and/or TSCA Title IV for plywood, particleboard, MDF, and these materials within other products like cabinets and doors. For any other composite wood products not covered by CARB/TSCA requirements, but used in interior spaces, these must at minimum be NAUF (have no added urea formaldehyde).
 - 2. 6.6 Bath, Kitchen, Laundry Surfaces
 - a. Use moisture-resistant backing materials per ASTM # D 6329 or 3273 behind tub/shower enclosures, apart from one-piece fiberglass enclosures which are exempt.
- E. Healthy Living Environment:
- 1. 7.5 Integrated Pest Management:
 - a. Sealants shall be low-VOC.
 - b. Openings greater than ¼" shall be equipped with rodent- and corrosion-proof screens.
 - c. Operable windows shall have screens.
 - d. All exterior doors and apartment entry doors shall be equipped with weatherstripping and door sweeps.
 - 2. 7.7 Ventilation:
 - a. In-unit ventilation system(s) shall comply with ASHRAE 62.2-2010 requirements for local mechanical exhaust system in bathrooms and kitchens, and whole-house mechanical ventilation. Design/measured flow rates shall not exceed ASHRAE 62.2-2010 requirements by more than 50%.
 - b. Individual bathroom fans shall be ENERGY STAR labeled; and either turn on with the light switch and off with associated automatic delay timer, or be activated by motion sensor, humidistat or other appropriate control.
 - c. Central ventilation system (s) shall comply with ASHRAE 62.1-2010 requirements for any corridors, stair wells, common and amenity areas and retail/commercial/office spaces. Design/measured flow rates shall not exceed ASHRAE 62.1-2010 requirements by more than 50%.
 - d. Any central rooftop fans shall be direct-drive and variable-speed
 - e. Any fan providing central ventilation with design CFM 300-2000 shall be equipped with an ECM motor.

PART 3 - EXECUTION

3.1 EXECUTION REQUIREMENTS

- A. Site Improvements:
 - 1. 3.1 Environmental Remediation:
 - a. Execute mitigation steps as determined by environmental assessment.
 - 2. 3.2 Minimization of Disturbance During Staging and Construction:

- a. Follow all Best Management Practices (BMPs) within the Total Erosion and Sedimentation Control (TESC) Plan.
 - b. Photograph all erosion control measures used throughout construction, including representative photos during rain events (as applicable) to document no visible off-site discharge.
 - 3. 3.3 Ecosystem Services/Landscape:
 - a. Any disturbed area must be reseeded or landscaped with plants that meet product requirements.
 - 4. 3.4 Surface Stormwater Management:
 - a. Treat or retain on-site precipitation equal to the 60th percentile precipitation event or maximum volume possible (if land disturbed is greater than or equal to 5,000 sq. ft.).
- B. Materials:
- 1. 6.10 Construction Waste Management
 - a. Designate on-site person or persons responsible for instructing workers and overseeing and documenting results of the waste management plan.
 - b. Distribute copies of the Waste Management plan to job site foreman, each sub-contractor, Owner and Architect
 - c. Provide facilities on-site for separation and storage of recycling and waste
- C. Healthy Living Environment:
- 1. 7.1 Radon Mitigation:
 - a. For all new construction projects in EPA Radon Zone 1, install passive radon-resistant construction features as follows:
 - 1) Seal the foundation with polyurethane caulk or the equivalent at all slab openings, penetrations, control or expansion joints and sump covers.
 - 2) Install below-slab venting and a vertical vent pipe that extends to daylight above the roofline.
 - 3) Install a junction box and electrical outlet within 10' of the vent pipe termination to allow for future conversion to an active radon reduction system.
 - 2. 7.5 Integrated Pest Management:
 - a. Seal all interior and exterior wall, floor, and joint penetrations with low-VOC caulking or other appropriate nontoxic sealing method (window screens, door sweeps, escutcheon plates, elastomeric sealant) to prevent pest entry.
 - b. Install rodent- and corrosion-proof screens (copper or stainless-steel mesh, or rigid metal cloth) for openings greater than ¼ inch.
 - c. Thoroughly seal entry points under kitchen and bathroom sinks to prevent pest entry.
 - 3. 7.7 Ventilation:
 - a. Install the following ventilation systems and ductwork in full accordance with ASHRAE 62.2-2010 and manufacturer's recommendations (This includes following guidelines for minimum straight duct length from fan boxes prior to first bend, type and size of duct, and number of bends to exterior wall termination):
 - 1) Local mechanical exhaust system in each bathroom and wire individual

- bathroom fans to turn on with light switch;
- 2) Local mechanical exhaust system in each kitchen;
- 3) Whole-house ventilation system.
- 4) Seal the foundation with polyurethane caulk or the equivalent at all slab openings, penetrations, control or expansion joints and sump covers.
- b. In the common spaces and hallways of multifamily buildings 4 stories or taller, install mechanical ventilation systems in full accordance with ASHRAE 62.1-2010 and manufacturer's recommendations.

END OF SECTION 018113

SECTION 019112 – TESTING AND VERIFICATION PLAN

1.1 OVERVIEW

- A. The Testing and Verification Plan (T&V Plan), draft, provided as part of the bid documents, is binding on the Contractor. The T&V Plan provides guidance in the execution of the Testing and Verification process. Just after the initial Testing and Verification scoping meeting the T&VC will update the plan which is then considered the “final” plan, though it will continue to evolve and expand as the project progresses. The applicable design professional of record shall be responsible for interpreting the specifications.

The T&V Plan shall be conducted as required to satisfy the requirements of the applicable Energy Star program.

1.2 ABBREVIATIONS AND DEFINITIONS

- A. Abbreviations: The following are common abbreviations used in this Specification and in the Testing and Verification Plan:
1. A/E: Architect and Design Engineers
 2. T&V Plan: Testing and Verification Plan
 3. T&VC: Testing & Verification
 4. PFC: Pre-Functional Checklist
 5. FPT: Functional Performance Test
 6. TAB: Test and Balance Contractor
 7. TCC: Temperature Controls Contractor
 8. CMa: Construction Manager (Owner’s)
 9. GC: General Contractor
 10. IC: Installing Contractor
 11. EC: Electrical Contractor
 12. MC: Mechanical Contractor
 13. Subs: Subs to Prime Contractors

1.3 PURPOSE OF THE TESTING AND VERIFICATION PLAN (T&V PLAN)

- A. The purpose of the Construction Phase T&V Plan is to:
1. Provide direction for the development of the T&V specifications by A/E, during the latter part of the Design Phase.
 2. Provide direction for the Testing and Verification process during construction, and to provide direction/resolution for issues and providing details for scheduling, participation of various parties, reporting of approvals, and coordination.

1.4 TESTING AND VERIFICATION SCOPE

- A. Testing and Verification is a systematic process of ensuring that designated building systems perform interactively per the design intent of the Owner's operational needs. Testing and Verification during the construction of this project is intended to achieve the following specific objectives:
1. Ensure that the building envelope, applicable equipment, and systems are installed properly and receive adequate operational checkout by installing contractors.
 2. Verify and document proper performance of equipment and systems.
 3. Complete the requirements of Energy Star and Enterprise Green Communities compliance.

1.5 SYSTEMS INCLUDED FOR TESTING AND VERIFICATION

- A. The following systems will be commissioned in this project. Refer to section 6 for additional details. All general references to equipment in this document refer only to equipment that is to be commissioned.

HVAC Equipment and System

(X)	Duct system	(X)	HVAC System Filtration
(X)	Ventilation systems (OA, Exhaust, range hood)	()	Combustion Appliances
(X)	HVAC Cooling/Heating Equipment	(X)	HVAC Cooling/Heating Equipment

Building Envelope

(X)	Below grade insulation	(X)	Thermal Bridging
(X)	Air Sealing	(X)	Aligned air barriers
(X)	Fenestration	(X)	Building / Space Pressurization

1.6 FORMS

- A. Forms to be used during Construction Phase are as required by Energy Star National Program Requirements.

1.7 ROLES AND RESPONSIBILITIES

- A. References
1. Energy Star National Program Requirements
 2. HVAC Design Report

3. HVAC Commissioning Checklist
4. Rater Checklist
5. Water Management System Builder Requirements

1.8 TEAM MEMBERS

- A. The members of the Testing and Verification Team consist of the T&V Consultant, PM, assigned members of the CMA, GC, A/E (particularly the architect and mechanical engineer), the mechanical contractor, any other installing subcontractors or suppliers of equipment. If known, the Owner's building or plant operator/ engineer is also a member of the Testing and Verification team.

1.9 GENERAL MANAGEMENT PLAN

- A. The T&V Consultant was hired by the Owner. In general, the T&VC coordinates the Testing and Verification activities with GC/CMA and A/E and reports to the Owner. The T&VC's responsibilities, along with all other contractors' Testing and Verification responsibilities are detailed in the specifications. All members must work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. Refer to the management protocols section below.

1.10 GENERAL DESCRIPTION OF ROLES

- A. General descriptions of the Testing and Verification roles are as follows:
 1. T&VC: Coordinates the Testing and Verification process, oversees and implements performance tests.
 2. GC/CMA: Facilitates the Testing and Verification process. Ensures that ICs perform their responsibilities and integrates Testing and Verification into the construction process and schedule.
 3. A/E: Perform construction observation, approve O&M manuals and assist in resolving problems.
 4. PM: Facilitates and supports the Testing and Verification process and gives final approval of the Testing and Verification work.
 5. Mfr.: The equipment manufacturers and vendors provide documentation to facilitate the Testing and Verification work and perform contracted startup.

1.11 DESIGN PHASE REVIEW

- A. During design phase T&VC shall assist the A/E team with reviewing the Energy Star program requirements and providing recommendations as required to facilitate successful testing. Items reviewed include, but not limited to; Air barrier, HVAC system location, defining system performance requirements, thermal bridging, adequate ventilation per ASHRAE 62.2.

1.12 TESTING AND VERIFICATION PROCESS

- A. This section sequentially details the Testing and Verification process by Testing and Verification task or activity.
1. Testing and Verification Coordination Meeting: A Testing and Verification scoping meeting is planned and conducted by the T&VC within 60 days of the beginning of construction. In attendance are the respective representatives of the Owner CMA, GC, ICs, T&VC, PM, A/E and the mechanical, electrical, controls, and TAB subs. At the meeting Testing and Verification parties are introduced and the Testing and Verification process reviewed, management and reporting lines determined. The flow of documents, how much submittal data the T&VC will receive, etc. will also be discussed. The T&V Plan is reviewed, process questions are addressed, lines of reporting and communications determined, and the work products list discussed. Also covered is the general list of each party's responsibilities, which is responsible to develop the startup plan for each piece of equipment and the proposed Testing and Verification schedule. The outcome of the meeting is increased understanding by all parties of the Testing and Verification process and their respective responsibilities. The meeting provides the T&VC additional information needed to finalize the T&V Plan, including the Testing and Verification schedule. Prior to this meeting the T&VC is given, by the A/E, all drawings and specifications and the construction schedule by trade. The T&VC keeps notes from the meeting and distributes them to each team member.
 2. Final Testing and Verification Plan – Construction Phase: The T&VC finalizes the draft T&V Plan using the information gathered from the scoping meeting. The initial Testing and Verification schedule is also developed along with a detailed timeline. The timeline is fine-tuned as construction progresses. In particular, 60 days prior to startup of the primary equipment, the T&VC meets with the GC/CM and develops a detailed Testing and Verification schedule. The Testing and Verification plan is approved by the GC/CM.
 3. Site Observation: The T&VC makes periodic visits to the site, to witness equipment and system installations. Final Schedule shall be determined at the scoping meeting.
 4. Additional Meetings: The T&VC attends selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in Testing and Verification. The GC/CMA provide the T&VC with information regarding substitutions, change orders and any Architect's Supplemental Instructions (ASI) that may affect Testing and Verification equipment, systems or the Testing and Verification schedule. The T&VC may review construction meeting minutes, change orders or ASIs for the same purpose. Later during construction, necessary meetings between various Testing and Verification team parties will be scheduled by the T&VC, through the GC/CMA, as required.
 5. Progress Reports and Logs: At the beginning of construction, the T&VC provides the CM with Testing and Verification progress reports after each visit. The T&VC regularly communicates with all members of the Testing and Verification team, keeping them apprised of Testing and Verification progress and scheduling issues through memos, progress reports, etc. The T&VC will keep all Testing and Verification materials in an organized notebook.

1.13 SUBMITTALS AND DOCUMENTATION

- A. **Standard Submittals:** The T&VC provides all ICs and Subs responsible for commissioned equipment with Testing and Verification documentation requirements for their respective equipment and systems through the GC/CMA. This data request typically coincides with the normal A/E submittal process. At minimum, this equipment data includes installation and start-up procedures, O&M data, performance data and control drawings. The T&VC reviews and approves submissions relative to Testing and Verification issues expressed in the contract documents, not for general contract compliance (which is the A/E's responsibility), unless specifically directed by the owner to do so. T&VC recommendations are provided to the A/E, owner or GC/CMA as directed.
- B. **Sampling Scope for T&VC Observation:** The following table provides a tentative list of the equipment and how much of the prefunctional checkout and startup work will be witnessed by the Testing and Verification authority.

<u>Equipment or System</u>	<u>Fraction To Be Observed by T&VC</u>
Thermal Barrier Inspection (TBI)	100%
Blower Door Test (Test conducted to determine leakage, ACH at 50 Pa)	Per sample set as defined in scope of work
Duct leakage tests/ pressure test (8% total allowable, 4% leakage to outside allowable). Consult Energy Star Rater Checklist	Per sample set
Ventilation test of exhaust systems. Consult Energy Star Rater Checklist	Per sample set

- C. **Deficiencies and Non-Conformance:** The Subs clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully at the bottom of the procedures form or on an attached sheet. The procedures form and deficiencies are provided to the T&VC within two days of test completion. The T&VC works with the Subs and vendors to correct and retest deficiencies or uncompleted items, involving the GC and others as necessary. The installing Subs or vendors correct all areas that are deficient or incomplete according to the checklists and tests. The T&VC recommends approval of the startup and initial checkout of each system to the GC.
- D. **Phased Testing and Verification:** Because of project size, this project (X_) will require startup and initial checkout to be executed in phases. (Final determination for Phased Testing and Verification shall be determined at Testing and Verification Scoping Meeting).

1.14 EXECUTION OF FUNCTIONAL TESTING PROCEDURES

- A. **Overview and Process:** The T&VC schedules functional tests through the CM/GC and affected Subs. For any given system, prior to performing functional testing, the T&VC waits until the GC/CMA has confirmed that the system is ready for functional testing. The T&VC oversees and implements the functional testing of all equipment and systems according to the Specifications and the T&V Plan.
- B. **Deficiencies and Retesting:** The T&VC documents the results of the test. Corrections of minor deficiencies identified are made during the tests at the discretion of the T&VC. The T&VC records the results of the test on the procedure or test form. Deficiencies or non-conformance issues are noted and reported to the AE/GC/CMA. ICs and Subs correct deficiencies, notify the

T&VC. The T&VC schedules retesting through the GC/CMA. Decisions regarding deficiencies and corrections are made at as low a level as possible, preferably between T&VC or GC/CMA and the Sub. For areas in dispute, final authority, besides the Owner's, resides with the A/E. The T&VC recommends acceptance of each test to the AE. The T&VC gives final approval on each test.

- C. Retesting Procedure: All testing and retesting shall be scheduled in advance. Any additional testing required due to test failure, lack of system readiness, and/or equipment is found to be out of compliance and any or part of the testing, verification and performance cannot be performed, additional Testing charges will be applied.

1.15 WRITTEN DOCUMENTATION

- A. Test results will be documented and included in progress reports as testing occurs. Final testing results shall be included in individual unit "Rater Checklist" reports and prepared for submission to the Energy Star Provider for final review and approval.

1.16 SCHEDULE

- A. Pre- Thermal Barrier Inspection. This is conducted prior to installation to review the overall enclosure quality.
- B. Thermal Barrier Inspection (TBI). This is conducted prior to installation of drywall to assure proper installation of the insulation systems.
- C. Rough-in Duct Test. Prior to drywall, the duct system is tested, with the air handler in place, to determine to initial quality of the duct installation. The intent is to identify deficiencies prior to drywall installation to facilitate repair, troubleshooting as required.
- D. Rouch-in Duct Test. If at all possible all systems are preferred to have a rough-in test to mitigate risk.
- E. Blower door test. This test shall be conducted as early as possible, once the air barrier is complete, and necessary appurtenances are in place (receptacle plates, caulking around MEP penetrations, windows caulked, etc.).
- F. Final Duct Leakage test. If unable to pass rough-in tests, a final duct leakage test will be conducted in conjunction with the blower door test to confirm Total Duct Leakage and Duct Leakage to Outside.
- G. The initial Testing and Verification schedule is summarized in Table 1.16.1.

Table 1.16.1. Initial Testing and Verification Schedule Summary

Task / Activity	Estimated Start Date	Estimated End Date
Initial scoping meeting and final plan	Within 60 days of notice to proceed	
Submittals obtained and reviewed	Before MEP construction	
Begin construction site visits/inspections	30% substantial completion	
Pre-TBI	Prior to insulation installation	
TBI/ Rough in Duct test	Prior to installation of drywall	
Blower door test/ final Duct Leakage testing	Air barrier complete	
Final Testing and Verification report	Within 4 weeks of Substantial Completion	

END OF SECTION 019112

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.
2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.
 - 6. Review and finalize protection requirements.
 - 7. Review procedures for noise control and dust control.
 - 8. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Survey of Existing Conditions: Submit survey.
- D. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- E. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove the following items:
 - a. Prior to start of construction, coordinate with Owner.
- C. Notify Owner of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials:
 - 1. Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - a. Owner will provide material safety data sheets for hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- E. On-site sale of removed items or materials is not permitted.

1.9 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

C. Sustainable Design Requirements for Building Reuse:

1. Maintain the existing building structural systems where indicated to remain. Do not demolish such existing construction beyond indicated limits.
2. Maintain the existing interior ceilings, interior partitions, and/or demountable walls where indicated to remain. Do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. A set of original building drawings will be provided. Owner does not guarantee that existing conditions are same as those indicated on the original building drawing set.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs and measured drawings. Comply with Section 013233 "Photographic Documentation."
 1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
 2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 3. Cover and protect furniture, furnishings, and equipment that have not been removed.
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Owner, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

- A. Existing Services/Systems to Remain: Maintain utilities and building systems and equipment to remain and protect against damage during selective demolition operations.
1. Maintain fire-protection facilities in service during selective demolition operations.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.
1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 2. Arrange to shut off utilities with utility companies.
 3. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.
 4. Demolish and remove existing building systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment and components.
 5. Abandon existing building systems, equipment, and components indicated on Drawings to be abandoned in place.
 - a. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - b. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.
 - c. Trash chute to be abandoned in place.
 6. Remove and reinstall/salvage existing building systems, equipment, and components indicated on drawings to be removed and reinstalled or removed and salvaged:

- a. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and components; when appropriate, reinstall, reconnect, and make equipment operational.
- b. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and components and deliver to Owner.

3.4 SALVAGE/REINSTALL

A. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least one (1) hour after flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Locate selective demolition equipment and remove debris and materials so as not to

impose excessive loads on supporting walls, floors, or framing.

- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
 - 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete:
 - 1. Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
 - 2. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive in accordance with recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 042213 - SITE CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make complete Site Concrete Unit Masonry assemblies and installations, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Concrete masonry units.
 - 2. Finished/Surfaced concrete masonry units
 - 3. Mortar and grout.
 - 4. Steel reinforcing bars.
 - 5. Masonry joint reinforcement.
 - 6. Ties and anchors.
 - 7. Embedded flashing.
 - 8. Miscellaneous masonry accessories.
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 05 50 13 "Site Miscellaneous Metal Fabrications".
 - 3. Section 32 13 23 "Cast-In-Place Concrete for Landscape Elements".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
 - 2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.4 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3)

copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.

- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Product Data: For each type of product indicated.
- H. Samples for Initial Selection:
 - 1. Pre-faced CMUs.
 - 2. Colored mortar.
 - 3. Weep holes/vents.
- I. Samples for Verification: For each type and color of the following:
 - 1. Pre-faced CMUs.
 - 2. Accessories embedded in masonry.
- J. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Landscape Architect and approved in writing.
 - 2. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units include data and calculations establishing average net-area compressive strength of units.
 - 3. Cementitious materials. Include brand, type, and name of manufacturer.
 - 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 5. Grout mixes. Include description of type and proportions of ingredients.
 - 6. Reinforcing bars.
 - 7. Joint reinforcement.
 - 8. Anchors, ties, and metal accessories.

- K. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- L. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 CONCRETE MASONRY UNITS

- A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
- C. CMUs: ASTM C 90.
 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength.
 2. Density Classification:

2.3 FINISHED/SURFACED CONCRETE MASONRY UNITS

- A. Regional Materials: Finished/Surfaced CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
- C. Finishes: Match referee sample provided by Landscape Architect. Finish shall be consistent throughout the entire unit.
- D. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength.
 - 2. Density Classification:

2.4 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cemex S.A.B. de C.V.
 - b. Essroc, Italcementi Group
 - c. Holcim (US) Inc.
 - d. Lehigh Cement Company
 - e. National Cement Company, Inc.; Coosa Masonry Cement.
 - f. Or similar as approved by landscape architect.
- F. Mortar Cement: ASTM C 1329.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. TXI, Inc;
 - b. Or similar as approved by landscape architect.
- G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
- H. Aggregate for Mortar: ASTM C 144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C 404.
 - J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.
 - L. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 1. Per contract documents.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
 1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.
 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304 or Type 316.
 4. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
 5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 6. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.

2.7 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- C. Post installed Anchors: Torque-controlled expansion anchors.

1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
 3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 A1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
 4. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Advanced Building Products Inc.; Peel-N-Seal.
 - 2) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - 3) Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - 4) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
 - 5) Polyguard Products, Inc.; [Polyguard 300] [Polyguard 400].
 - 6) Sandell Manufacturing Co., Inc.; Sando-Seal.
 - 7) Williams Products, Inc.; Everlastic MF-40.
 - 8) Or similar as approved by landscape architect.
 - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- D. Application: Unless otherwise indicated, use the following:
1. Where flashing is indicated to receive counter flashing, use metal flashing.
 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
 4. Where flashing is fully concealed, use metal flashing or flexible flashing.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- 2.8 MISCELLANEOUS MASONRY ACCESSORIES
- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Heckmann Building Products Inc.; No. 376 Rebar Positioner.

- b. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
- c. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
- d. Or similar as approved by landscape architect.

2.9 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use masonry cement mortar unless otherwise indicated.
 - 3. For exterior masonry, use masonry cement mortar.
 - 4. For reinforced masonry, use masonry cement mortar.
 - 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, [Proportion] [Property] Specification. Provide the following types of mortar for applications stated unless another type is indicated [or needed to provide required compressive strength of masonry].
 - 1. For reinforced masonry, use Type S.
 - 2. For mortar parge coats, use Type S or Type N.
 - 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 - 3. Provide grout with a slump of [8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that foundations are within tolerances specified.
 - 2. Verify that reinforcing dowels are properly placed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
 - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
 - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/2 inch total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet or 1/2 inch (12 mm) maximum.
 - 2. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet'
 - 3. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet.
- C. Joints:
 - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
 - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners and at other locations.
- B. Bond Pattern for Masonry: Unless otherwise indicated, lay exposed masonry in running bond. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.

- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Revise three subparagraphs below if different spacing is required; delete if shown on Drawings.
 - 2. Space reinforcement not more than 16 inches o.c.
 - 3. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 4. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings [in addition to continuous reinforcement].
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, pipe enclosures, and other special conditions.

3.7 REINFORCED UNIT MASONRY INSTALLATION

- A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.8 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Testing Prior to Construction: One set of tests.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for [mortar air content] [and] [compressive strength].
- G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.9 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Chips in finished/surfaced units shall be 1/8" in any direction or larger are not acceptable and shall be replaced accordingly.
- C. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- D. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- E. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.10 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 044216 - SITE STONE BLOCKS, BOULDERS AND SLABS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make a complete Stone Slabs or Boulder assemblies and installations, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Stone block retaining walls and facades
 - 2. Stone block benches.
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 32 13 16 "Cast-In-Place Concrete for Landscape Elements".

1.2 SUBMITTALS:

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Data Forms: Submit data with complete illustrations and / or descriptions for the following:
 - 1. Stone: Source, color, and general character and sizes.

2. Samples: Approved samples shall be the standards for stone.
- 1.3 DELIVERY, STORAGE AND HANDLING: Store materials well protected from inclement weather, and admixture of foreign material.
- 1.4 QUALITY CONTROL
 - A. Contractor shall have a minimum of 10 years similar successful rockwork installation and stone project experience.
 - B. Supplier shall be capable of supplying stone in the quantities and sizes shown and quarried from a single area of quarry such that all stone for any use shall match each other.
 - C. MOCKUPS
 1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 2. Build mockups of oversized stone slab retaining walls demonstrating typical joints, texture, color, and standard of workmanship.
 3. Locate mockups in the locations indicated, or if not indicated, as directed by Landscape Architect or General Contractor
 4. Notify Landscape Architect five (5) days in advance of the dates and times when mockups will be constructed.
 5. Mockup shall include the various wall depth conditions in a minimum 15' wide by 5' high mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging completed work.
 - a. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations.
 - b. Approved mockups may become part of the completed work if undisturbed at time of substantial completion.

PART 2 - PRODUCTS

- 2.1 BLOCKS, BOULDERS and SLABS:
 - A. Stone shall be per contract documents noting finishes, color, material type and sizes.
 1. Neither breadth nor thickness of any piece shall be less than one-third (1/3) its length. Gradations as hereinafter designated shall govern the on-site distribution.
 2. Stones shall be free from soil, organic matter and each load shall be reasonably graded from the smallest to the largest size specified. Stones smaller than the smallest size specified shall not exceed the amount of the smallest size of each load.
 3. Control of gradation will be visual inspection. The Owner reserves the right of rejection based upon approved samples.
- 2.2 STONE FOUNDATION:
 - A. Compacted sub-base as detailed.
 1. Texas Department of Transportation specification: TXDOT Flex Base #247, Grade B, Type 3 Base Material.

2. Compact to 95% density.
- B. Concrete sub-slab as detailed.
 1. 3500 PSI concrete minimum at thickness and sizes noted.
 2. Reinforcing per details.
 3. Broom finish.
- 2.3 STONE BACKFILL
 - A. 3/4" Drainage Gravel with Mirafi FW402 drainage fabric backing against the stone as shown in the details.
- 2.4 STONE SUBDRAINAGE: Refer to Section 33 4300 "Site Landscape Drainage".

PART 3 - EXECUTION

- 3.1 GENERAL
 - A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.
- 3.2 LAYOUT: Layout all areas on approved rough grade for limits of stone installation. Proceed no further without approval of the Landscape Architect.
- 3.3 INSTALLATION: Begin the installation from the bottom to top of slope, laying stones normal to the slope. Stones shall be mixed with the size limitations shown on the Drawings. The intent is not to have the appearance "even" but "natural".
- 3.4 HAND PLACED BLOCKS/BOULDERS/SLABS:
 - A. Boulder/Block stone shall be placed upon an approved subgrade bed or sub-slab/fountain basin and slope so as to produce a well-keyed mass of rock with the least practicable amount of void spaces. Rocks shall be placed with their longitudinal axis normal to the embankment face and arranged so that each rock above the foundation course has a three-point bearing on the underlying rocks. Foundation course is the course placed on the slope in contact with the ground surface. Bearing on smaller rocks which may be used for chinking voids will not be acceptable.
 - B. Boulders, stone slabs and large ledge stone shall be set under observation of the landscape architect. All necessary leveling and adjustments shall be a part of this work.
 - C. Clean stone slabs and boulders by light washing to remove excess soil and construction dust.
- 3.5 CLEAN-UP: At completion, remove from the project site all excess materials, debris, rubbish, etc., resulting from the operations of this section.

END OF SECTION

SECTION 055214 - SITE GUARD AND HAND RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make a complete metal Pipe and Tube Railing assemblies and installations, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Steel pipe, bar and tube railings.
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 05 50 13 "Site Miscellaneous Metal Fabrications"
 - 3. Section 32 13 15 "Landscape Architectural Cement Concrete Paving"
 - 4. Section 32 13 16 "Architectural and Decorative Concrete Cement Paving"
 - 5. Section 32 13 23 "Cast-In-Place Concrete for Landscape Elements"

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
 - 2. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
 - 3. Stainless Steel: 60 percent of minimum yield strength.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 75 lb./ ft. applied in any direction.
 - b. Concentrated load of 200 lb. applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lb. applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Differential values in subparagraph below (for aluminum in particular) are suitable for most of the U.S.
 2. Temperature Change: 120 deg F ambient; 180 deg F, material surfaces.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Product Data: For the following:
1. Manufacturer's product lines of mechanically connected railings.
 2. Railing brackets.
 3. Grout, anchoring cement, and paint products.
- H. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- I. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes on stainless steel.
- J. Samples for Verification: For each type of exposed finish required.
1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 2. Fittings and brackets.
 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of finishing connecting members at intersections.

- K. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer testing agency.
- B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and step systems and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Aluminum Pipe and Tube Railings:
 - a. Blum, Julius & Co., Inc.
 - b. Braun, J. G., Company; a division of the Wagner Companies.
 - c. Hollaender Manufacturing Company.
 - d. Kee Industrial Products, Inc.
 - e. Moultrie Manufacturing Company.
 - f. Sterling Dula Architectural Products, Inc.; Div. of Kane Manufacturing.
 - g. Superior Aluminum Products, Inc.
 - h. Tubular Specialties Manufacturing, Inc.
 - i. Tuttle Railing Systems; Div. of Tuttle Aluminum & Bronze, Inc.
 - j. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - k. Or approved others.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Tubing: ASTM A 500 (cold formed)
- C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.4 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 304.
- B. Pipe: ASTM A 312/A 312M, Grade TP 304.
- C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.
- D. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316L.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 3. Aluminum Railings: Type 304 stainless-steel fasteners.
 - 4. Stainless-Steel Railings: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
 - 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum and stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with Section 09 9113 "Exterior Painting".

- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- G. Shop Primer for Galvanized Steel: Water based galvanized metal primer complying with MPI#134.
- H. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Those approved by Landscape Architect submitted by contractor.
- I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- J. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or non-welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- K. Form changes in direction as follows:
 1. As detailed.
 2. Or approved by submittal shop drawings.
- L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Q. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.9 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
 - 2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
 - 3. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 4. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 5. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - 6. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
 - 1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
- G. Shop-Painted Finish: Comply with Section 099100 "Painting."
 - 1. Color: As selected by Architect from manufacturer's full range.
- H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
 - 1. Color selected by Architect from manufacturer's full range.

2.10 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.

- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. 180-Grit Polished Finish: Oil-ground, uniform, directionally textured finish.
- D. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
- E. Polished and Buffed Finish: Oil-ground, 180-grit finish followed by buffing.
- F. Directional Satin Finish: No. 4.
- G. Dull Satin Finish: No. 6.
- H. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

3.2 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.3 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.4 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.5 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post.
- D. Leave anchorage joint exposed with anchoring material flush with adjacent surface.
- E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
 - 2. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
 - 3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.6 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and per details.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and per details.
- C. Attach railings to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.7 ADJUSTING AND CLEANING

- A. Clean railing systems by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Molded (expanded) polystyrene foam-plastic board insulation.
3. Graphite-polystyrene foam-plastic board insulation.
4. Reflective insulation and radiant barriers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to

- Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than Class B, 75 and 450 when tested in accordance with ASTM E84.
- B. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
- C. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (XPS)

- A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25 psi minimum compressive strength; unfaced.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. DuPont de Nemours, Inc.
 - b. Owens Corning
 - c. The Dow Chemical Company

2.3 MOLDED (EXPANDED) POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (EPS)

- A. Molded (Expanded) Polystyrene Board Insulation, Type IV, Faced: ASTM C578, Type IV, 25 psi minimum compressive strength.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulfoam; a Carlisle Company

2.4 GRAPHITE-POLYSTYRENE FOAM-PLASTIC BOARD INSULATION (GPS)

- A. Graphite-Polystyrene Foam-Plastic Board Insulation, Type IV, Faced: ASTM C578, Type IV, 25 psi minimum compressive strength; 1.1-perm maximum vapor permeance at 1-inch

thickness per ASTM E96/E96M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Insulfoam; a Carlisle Company

2.5 REFLECTIVE INSULATION AND RADIANT BARRIERS

- A. Sheet Radiant Barriers: ASTM C1313/C1313M with at least one surface with emittance value of 0.1 or less as measured per ASTM C1371.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Covertex Flexible Packaging; division of Balcan Plastics
 - b. Innovative Insulation, Inc.
 - c. ISI Building Products
 2. Construction: Foil on one side of substrate.
 3. Water-Vapor Transmission: 1 perm, maximum.

2.6 INSULATION FASTENERS

- A. Insulation Fastener Accessories: Provide double-pointed weld pins, lagging pins, quilting pins, duct liner pins, insulation hangers, specialty washers, special caps, j-hooks, capacitor discharge annular weld pins, capacitor discharge acoustical lagging pins, and other accessory materials that are recommended in writing by insulation fastener manufacturer to produce complete insulation supports.

2.7 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
 2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
- B. Miscellaneous Application Accessories:
 1. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
 2. Crack Sealer: Closed-cell insulating foam in aerosol dispenser recommended in writing

- by insulation manufacturer for filling gaps in board insulation.
- 3. Detailing Foam Insulation for Voids: Urethane foam complying with AAMA 812, low expansion pressure suitable for filling insulation gaps and voids adjacent to openings to protect against water, air, and sound intrusion.
- 4. Tapes for Reflective Insulation and Barriers:
 - a. Aluminum-foil tape for repairs or splicing material.
 - b. Double-sided tape for adhering to metal framing or overlapping material.
 - c. Reinforced-foil tape for sealing tears or cuts in sheet vapor barrier.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or those that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products, applications and applicable codes.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended in writing by manufacturer.
 - 1. Fit courses of insulation between obstructions, with edges butted tightly in both directions, and with faces flush.
 - 2. Press units firmly against inside substrates.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
 - 2. Detailing Foam Insulation for Voids: Apply in accordance with manufacturer's written instructions.
- B. Spray-Applied Cellulosic Insulation: Apply spray-applied insulation in accordance with manufacturer's written instructions.
 - 1. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
 - 2. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

3.5 INSTALLATION OF BOARD INSULATION

- A. Install board insulation in accordance with manufacturer's written instructions per project applications and conditions.

3.6 INSTALLATION OF REFLECTIVE AND RADIANT BARRIERS INSULATION

- A. Install sheet reflective insulation in accordance with ASTM C727.
- B. Install sheet radiant barriers in accordance with ASTM C1744.

3.7 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silane-modified polymer joint sealants.
6. Mildew-resistant joint sealants.
7. Butyl joint sealants.
8. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silane-modified polymer joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

- B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

- D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
 1. Joint-sealant location and designation.
 2. Manufacturer and product name.
 3. Type of substrate material.
 4. Proposed test.
 5. Number of samples required.
- B. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- D. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.
- E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.7 MOCKUPS

- A. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.
 - 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 - 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
 - 7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each kind of sealant and joint substrate.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - 5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.9 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.10 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. Sika Corporation - Building Components
- B. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation
 - b. Sherwin-Williams Company (The)
 - c. Sika Corporation - Building Components
- C. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation
 - b. The Dow Chemical Company
- D. Silicone, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Pecora Corporation
- b. Sika Corporation - Building Components

2.4 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Pecora Corporation
- b. Sika Corporation - Building Components
- c. Tremco Incorporated

- C. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. The Dow Chemical Company

2.5 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Pecora Corporation
- b. Sherwin-Williams Company (The)
- c. Sika Corporation - Building Components

d. Tremco Incorporated

- B. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

2.6 IMMERSIBLE JOINT SEALANTS

- A. Immersible Joint Sealants: Suitable for immersion in liquids; ASTM C1247, Class 1; tested in deionized water unless otherwise indicated.
- B. Urethane, Immersible, S, NS, 100/50, NT, I: Immersible, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses NT and I.
1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. Tremco Incorporated

2.7 SILANE-MODIFIED POLYMER JOINT SEALANTS

- A. Silane-Modified Polymer, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, silyl-terminated polyurethane joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. Pecora Corporation
- b. Sherwin-Williams Company (The)
- c. Sika Corporation - Building Components
- B. Silane-Modified Polymer, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, silyl-terminated polyurethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- a. Polymeric Systems, Inc.; PPG Industries, Inc.
- b. Sika Corporation - Building Components
- C. Silane-Modified Polymer, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and

minus 25 percent movement capability, traffic- and nontraffic-use, joint sealant; ASTM C920, Type S, Grade NS, Class 25, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Soudal Accumetric

2.8 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silane-Modified Polymer, Mildew Resistant, S, NS, 50, NT: Mildew-resistant, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, polyurea joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

2.9 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation
 - b. Sika Corporation - Building Components

2.10 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation
 - b. Sherwin-Williams Company (The)
 - c. Tremco Incorporated

2.11 JOINT-SEALANT BACKING

- A. Sealant Backing Material: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alcot Plastics Ltd.
 - b. Construction Foam Products; a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.12 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
 4. Provide flush joint profile at locations indicated on Drawings in accordance with Figure 8B in ASTM C1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings in accordance with Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - a. Extent of Testing: Test completed and cured sealant joints as follows:
 - 1) Perform 10 tests for the first 1000 ft. of joint length for each kind of sealant and joint substrate.
 - b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate

separately; extend cut along one side, verifying adhesion to opposite side.
Repeat procedure for opposite side.

- c. Inspect tested joints and report on the following:
 - 1) Whether sealants filled joint cavities and are free of voids.
 - 2) Whether sealant dimensions and configurations comply with specified requirements.
 - 3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 - e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

- C. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

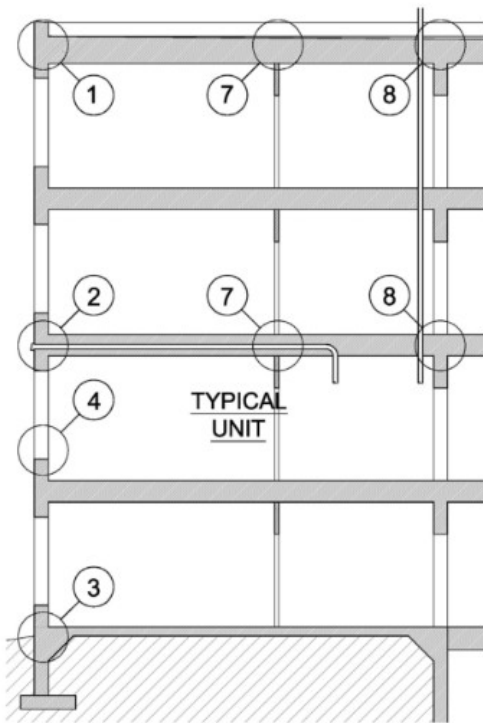
3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

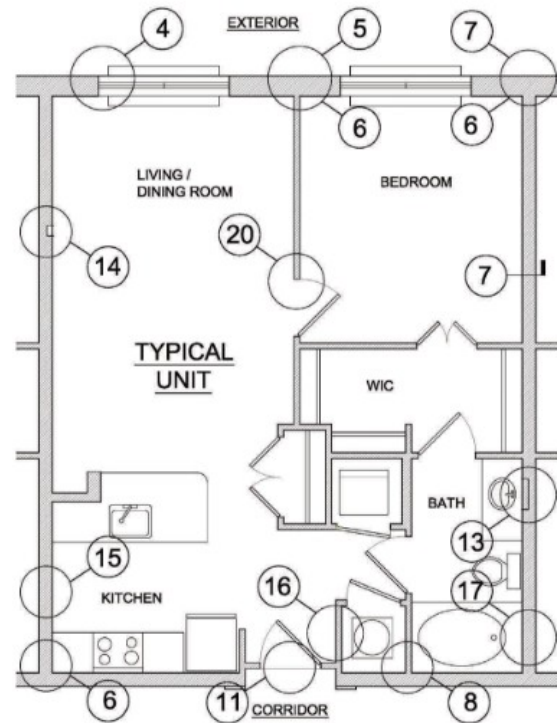
3.7 AIR SEAL GUIDE

- A. The following diagrams provide **general guidelines** for the locations and installation of sealants for this project. Not all diagrams will apply. The contractor shall coordinate the placement of the sealant with the appropriate trade and be responsible for the correct completion of all required sealed areas and penetrations.
- B. Source: MULTIFAMILY MASONRY AIR SEALING GUIDE – SWA Knowledge Hub

MULTIFAMILY MASONRY AIR SEALING GUIDE



SECTION KEY
TYPICAL MULTIFAMILY BUILDING



PLAN KEY
TYPICAL UNIT PLAN

RULES OF THUMB

1. Use shrink/crack-proof caulk to seal gaps smaller than 1/4"
2. Use expanding foam to seal gaps larger than 1/4"
3. Spray-on air sealing products are very effective (e.g. EcoSeal)
4. Use low-expanding foam at window/door openings
5. Use temperature-appropriate sealant (e.g. high-temp caulk at flues, heating pipes, etc.)
6. Clean out cracks before applying sealant (e.g. compressed air, vacuum, damp cloth, etc.)
7. Assign responsibility to one trade/person for confirming completion of air sealing tasks (this guide includes suggestions for which trades should be initially responsible for each task)

MULTIFAMILY MASONRY AIR SEALING GUIDE

1

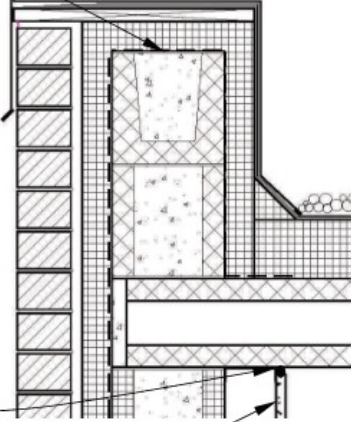
EXTERIOR WALL - PARAPET
(GRAVEL STOP SIMILAR)

(SECTION VIEW)

A. EXTERIOR
AIR BARRIER

B. SEAL
DRYWALL
TO PLANK

C. INTERIOR AIR BARRIER



Notes:

A. Typically fluid-applied or adhesive membrane on CMUs (e.g. Grace / Henry products)

B. Intent: reduce leakage between wall cavity and apartment

C. Typically drywall

Responsibilities:

Envelope: A
Drywall: B, C

2

EXTERIOR WALL - MIDDLE
(DEMISING/CORRIDOR WALLS SIM.)

(SECTION VIEW)

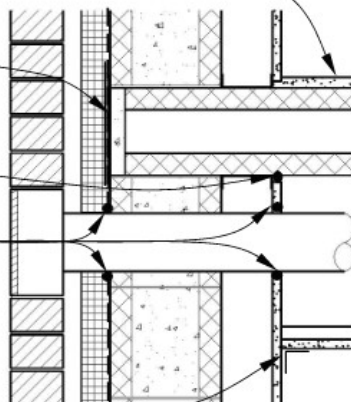
A. SELF-LEVELING
SUBFLOOR

B. SHEET
MEMBRANE
OVER PLANK
EDGE

C. SEAL
DRYWALL
TO PLANK

D. SEAL ALL
PENETRATIONS

E. TAPE AND MUD



Notes:

A, C. Intent: reduce leakage between floor and wall cavities

A. Option: seal drywall to slab (in lieu of plank)

B. Incorporate with exterior air barrier

D. Includes ducts, pipes, wires, etc. (high priority)

E. Typical

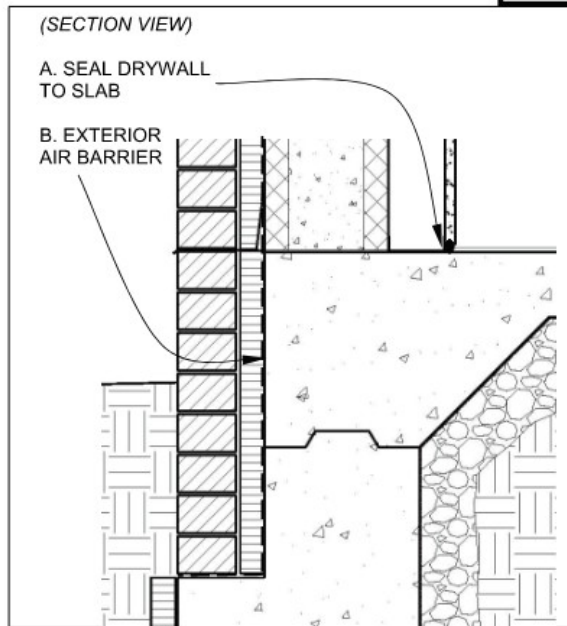
Responsibilities:

Envelope: B
Drywall: C, E
Mech/elec/plumb: D

MULTIFAMILY MASONRY AIR SEALING GUIDE

3

EXTERIOR WALL - BOTTOM



Notes:

A. Intent: reduce leakage between wall cavity and apartment

A. Option: self-leveling subfloor (i.e. gypcrete)

- Seal any remaining gaps between self-leveling subfloor and drywall with caulk

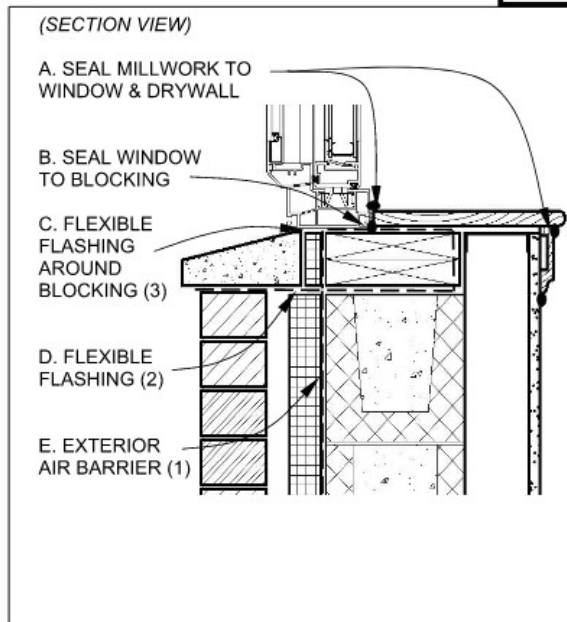
Responsibilities:

Drywall: A

Envelope: B

4

WINDOW SILL
(HEAD AND JAMB SIMILAR)



Notes:

A. Intent: reduce leakage between wall cavity and apartment

B. Intent: reduce leakage between wall cavity and outdoors

B. Seal any gaps at shims

C, D, E: Sequence of installation shown (1, 2, 3)

D. Wrap entire window opening with flexible flashing

Responsibilities:

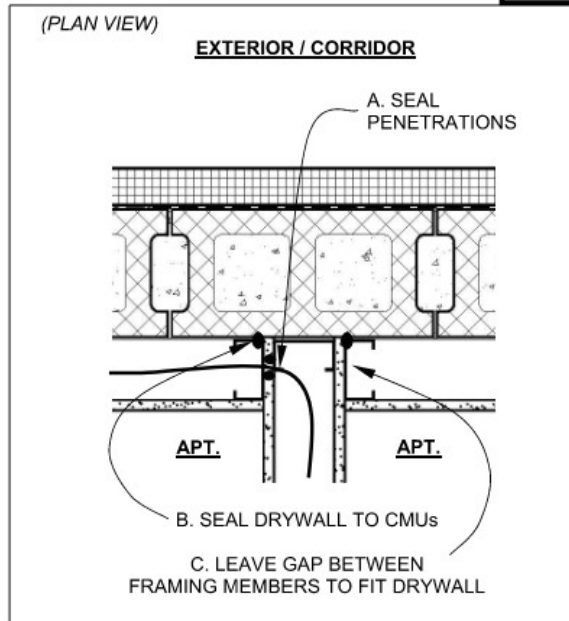
Envelope: B, C, D, E

Paint: A

MULTIFAMILY MASONRY AIR SEALING GUIDE

5

DEMISING WALL/INTERIOR PARTITION
AT EXTERIOR/CORRIDOR WALL



Notes:

A, B. Intent: reduce leakage between exterior/corridor wall and demising wall / interior partition

A. Includes ducts, pipes, wires, etc.

B. Size of gap depends on thickness of drywall to be installed

Responsibilities:

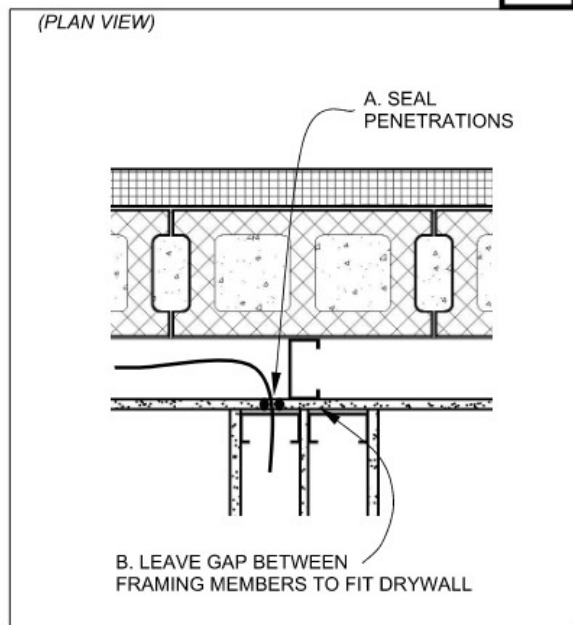
Framing: C

Drywall: B

Mech/elec/plumb: A

6

ALTERNATE METHOD FOR WALL
CAVITY SEPARATION



Notes:

A. Intent: reduce leakage between exterior/corridor wall and demising wall / interior partition

A. Includes ducts, pipes, wires, etc.

B. Size of gap depends on thickness of drywall to be installed

Responsibilities:

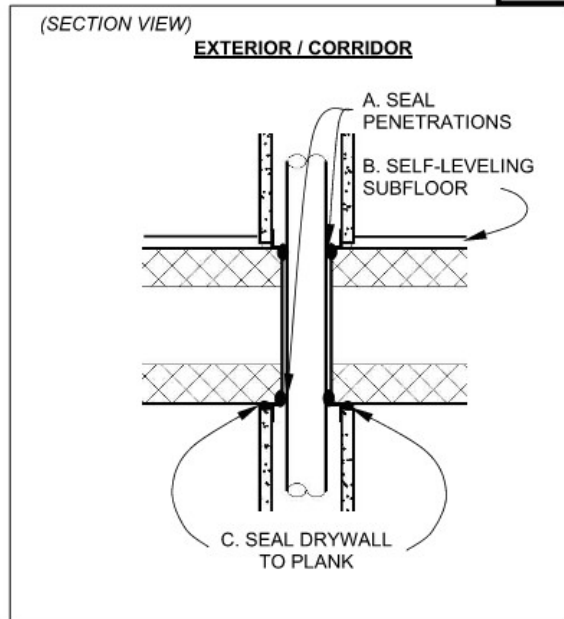
Framing: B

Mech/elec/plumb: A

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7

INTERIOR WALLS - TOP/BOTTOM



Notes:

A, B, C. Intent: reduce leakage between wall cavities and apartments

A. Includes ducts, pipes, wires, etc.

B. Size of gap depends on thickness of drywall to be installed

C. Option: seal drywall to slab (in lieu of plank)

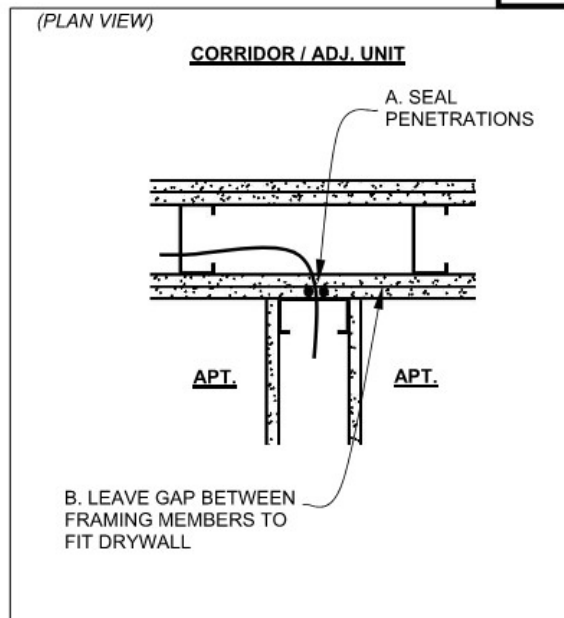
Responsibilities:

Drywall: C

Mech/elec/plumb: A

8

INTERIOR PARTITION AT DEMISING/
CORRIDOR WALL



Notes:

A. Intent: reduce leakage between corridor/demising wall and interior partition

A. Includes ducts, pipes, wires, etc.

B. Size of gap depends on thickness of drywall to be installed

Responsibilities:

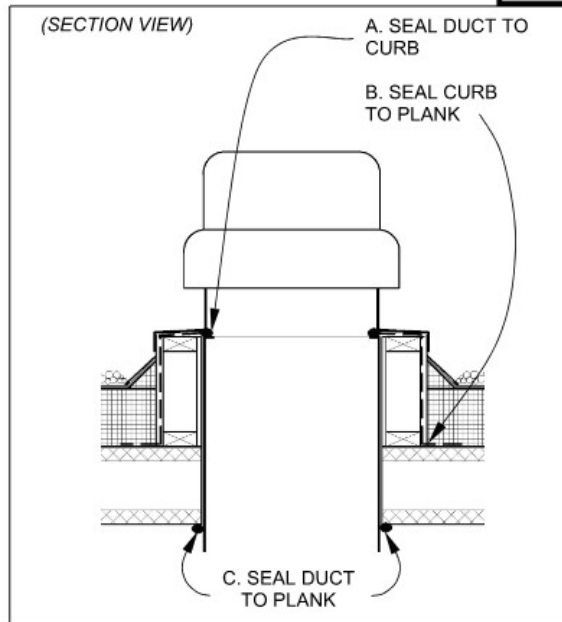
Framing: B

Mech/elec/plumb: A

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9

ROOF FAN



Notes:

A, B. Intent:

- Reduce leakage between conditioned & unconditioned space
- Reduce duct leakage

C. Intent: Reduce leakage between conditioned & unconditioned space

Note: connect fan to curb tightly (but do not seal permanently to allow removal for maintenance)

Responsibilities:

Roofing: B

Mech/elec/plumb: A, C

10

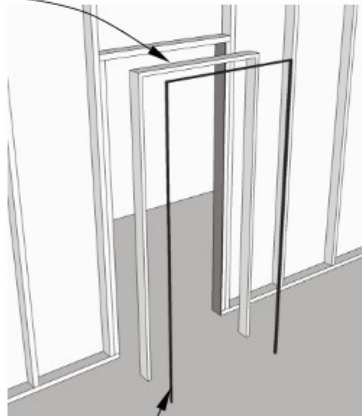
(NOT USED)

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11

CORRIDOR/EXTERIOR DOOR

A. SEAL DOOR FRAME
TO FRAMING



B. INSTALL GASKETS/
WEATHERSTRIPPING
AND DOOR SWEEP

Notes:

A, B. Intent: reduce leakage between apartment and corridor/outdoors

A, B. Also applicable at rooms that are vented to outdoors (i.e. boiler room, trash room, etc.)

Responsibility:

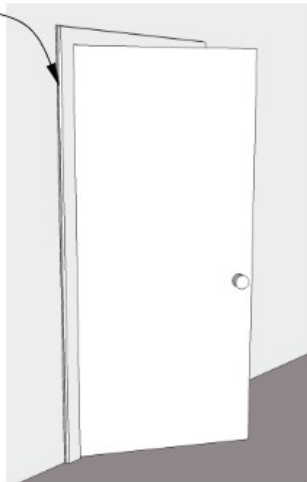
Framing: A

Window/door: B

12

MILLWORK (TRIM)

A. SEAL MILLWORK
TO DRYWALL



Notes:

A. Seal ALL edges of millwork

A. Intent: reduce leakage between wall cavities and apartment

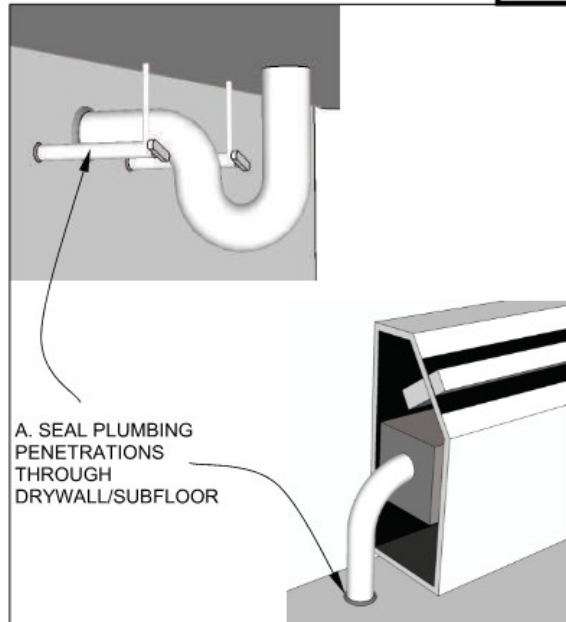
Responsibility:

Drywall: A

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13

PLUMBING PENETRATIONS



Notes:

A. Seal all penetrations BEFORE installing cabinetry

A. Intent: reduce leakage between wall cavities and apartment

A. Seal penetrations before installing escutcheons

A. Typical plumbing penetrations include:

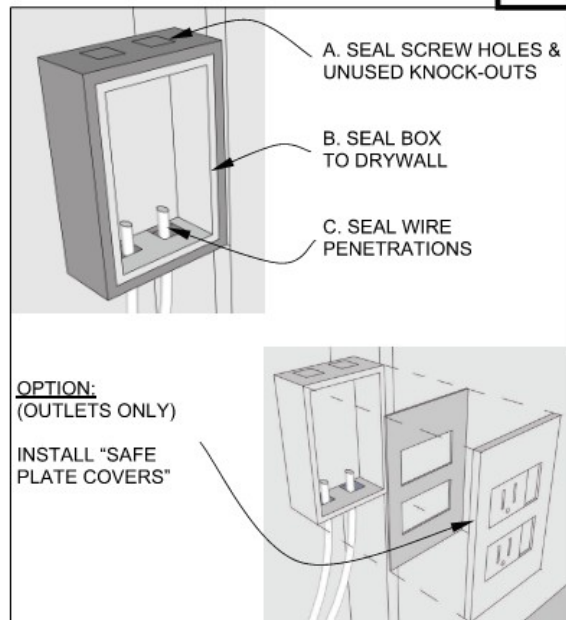
- Sink faucet supplies & drain
- Toilet supply
- Showerhead stub-out
- Heating supply/return
- Gas supply
- Sprinklers

Responsibility:

Drywall: A

14

ELECTRICAL BOXES



Notes:

A, B, C. Intent: reduce leakage between structural cavities and apartment

A, B, C. Includes boxes in floors and ceilings

A, C. Options:

- Caulk
- Foam
- Mastic (over entire box)
- Putty pack

Option (at outlets only): In lieu of A/B/C, install air-tight covers and gaskets

Responsibility:

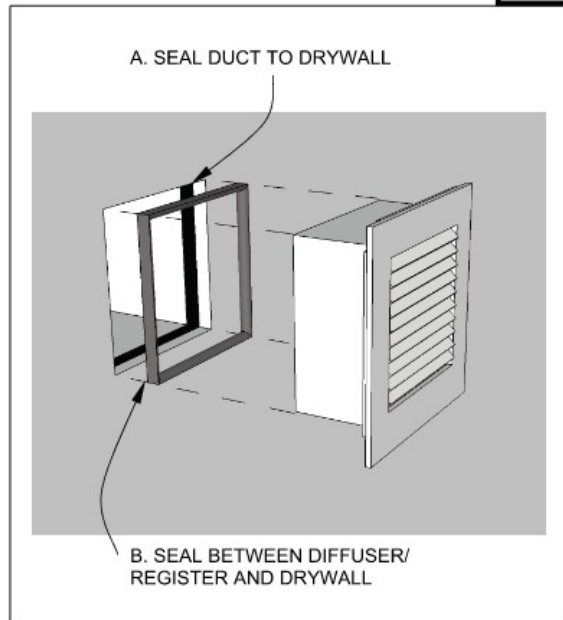
Drywall: B

Electrical: A, C

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15

DUCTWORK



Notes:

A. Seal penetration BEFORE installing diffuser/register

A. Intent:

- Reduce leakage between wall cavities and apartment
- Reduce duct leakage into wall cavities

A. Typical penetrations include:

- Heating/cooling ductwork
- Exhaust ductwork
- Exhaust fans
- Dryer vent

B. Suggested (options: caulk, foam, gasket)

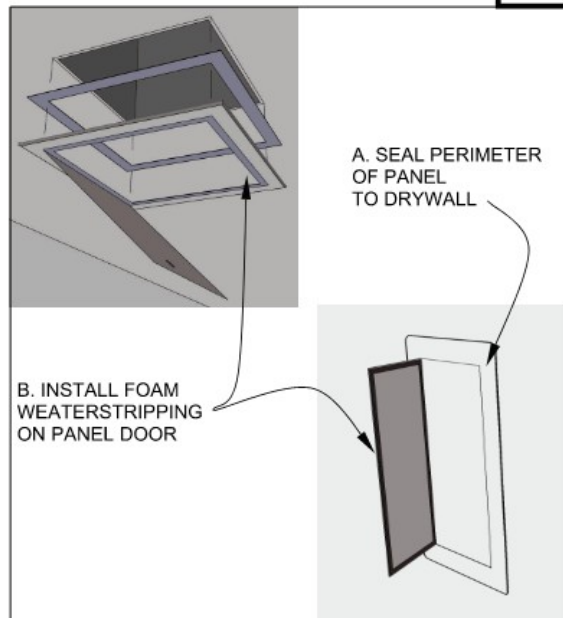
Responsibility:

Drywall: A

Mechanical: B

16

UTILITY/ACCESS PANELS



Notes:

A, B. Intent: reduce leakage between structural cavities and apartment

A. Options:

- Caulk
- Foam
- Gasket

B. Inexpensive, adhesive-backed weatherstripping usually works best

Responsibility:

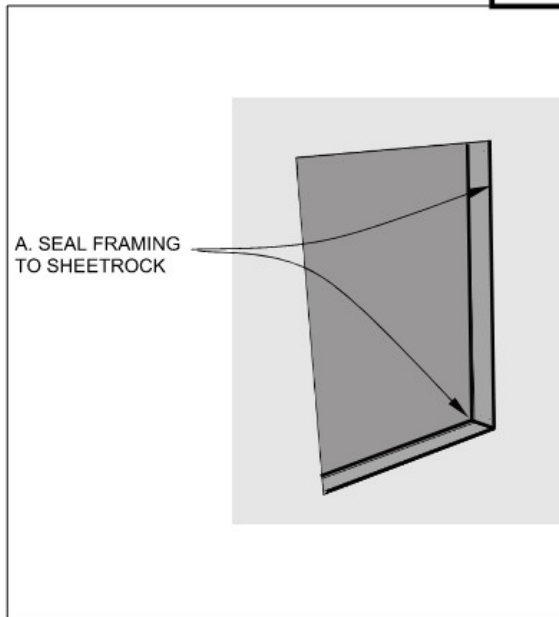
Drywall: A

Mech/elec/plumb: B

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17

RECESSED COMPONENTS



Notes:

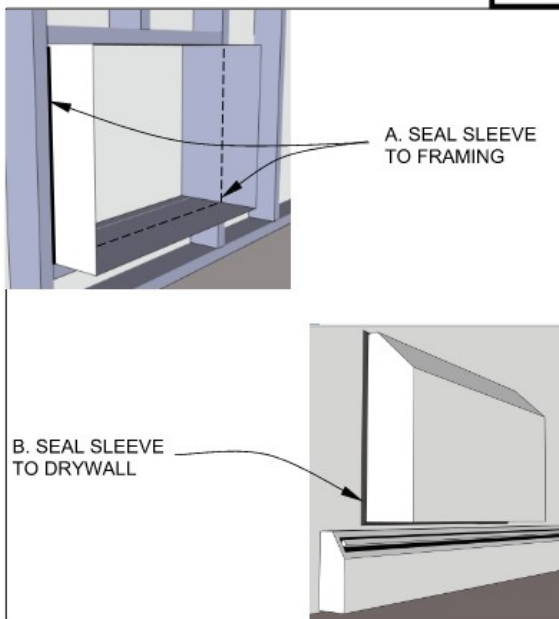
- A. Seal all cracks/seams BEFORE recessed component is installed
- A. Intent: reduce leakage between wall cavities and apartment
- A. Seal holes in metal framing (if applicable)
- A. Typical recessed components include:
 - Medicine cabinet
 - Fire extinguisher cabinets
 - Mailboxes

Responsibility:

Drywall: A

18

PACKAGED HEATING/COOLING EQUIPMENT (PTACs)



Notes:

- A. Intent: reduce leakage between apartment and outdoors
- B. Intent: reduce leakage between wall cavity and apartment

Additional measures:

- Seal PTAC equipment to sleeve
- Provide insulated interior cover with compressible gasket

Responsibility:

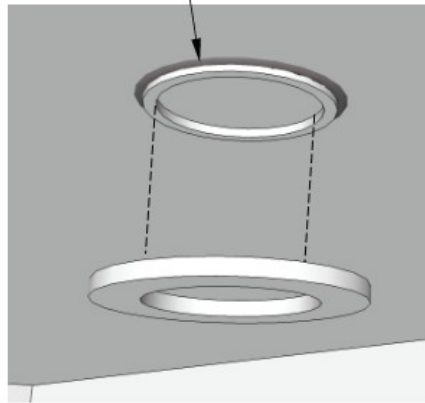
Mechanical: A
Drywall: B

MULTIFAMILY MASONRY AIR SEALING GUIDE

19

RECESSED LIGHTING

A. SEAL RECESSED LIGHT
HOUSING TO DRYWALL



Notes:

A. Intent: reduce leakage between attic/floor cavities and apartment

A. Options:
- Caulk
- Foam
- Gasket

A. Use insulation contact air-tight cans (ICAT)

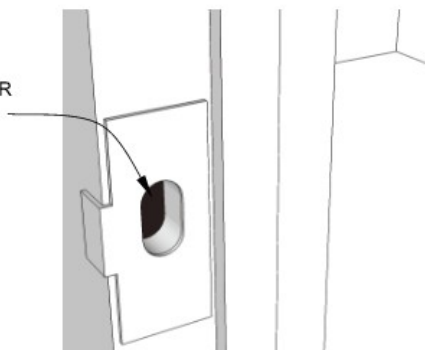
Responsibility:

Drywall: A

20

DOOR LATCH HOLE

A. SEAL DOOR
STRIKE



Notes:

A. Intent: reduce leakage between wall cavities and apartment

A. Expanding foam works best (be careful not to overspray)

Responsibility:

Drywall: A

END OF SECTION 079200

SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel frames.

B. Related Requirements:

1. Section 081416 "Flush Wood Door" for solid core wood doors.
2. Section 087111 "Door Hardware (Descriptive Specification)" for door hardware for solid core wood doors.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, fire-resistance ratings, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each frame type.
2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
3. Locations of reinforcement and preparations for hardware.
4. Details of each different wall opening condition.
5. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

D. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.

E. Product Schedule: For hollow-metal frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of fire-rated hollow-metal frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
 - 2. Oversize Fire-Rated Frames: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that frames comply with standard construction requirements for tested and labeled fire-rated assemblies except for size.

2.2 STANDARD STEEL FRAMES

- A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Interior Standard Steel Frames: SDI A250.8. At locations indicated in the Door and Frame Schedule on Drawings.
 - 1. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - 2. Construction: Full profile welded.
 - 3. Exposed Finish: Prime.

2.3 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

2.4 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

2.5 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
 - 1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.

2.6 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding,

filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

- B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with SDI A250.11.
- B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - 1. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - 2. Install frames with removable stops located on secure side of opening.
- C. Fire-Rated Openings: Install frames according to NFPA 80.
- D. Floor Anchors: Secure with post-installed expansion anchors.
 - 1. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
- E. Solidly pack mineral-fiber insulation inside frames.
- F. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
- G. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- H. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

3.3 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors for transparent finish.
2. Solid-core five-ply flush wood doors for opaque finish.
3. Hollow-core flush wood doors for opaque finish.
4. Fire-rated wood door frames.
5. Light frames and louvers.

B. Related Requirements:

1. Section 099114 "Exterior Painting" for field finishing doors.
2. Section 099124 "Interior Painting" for field finishing doors.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Solid-core five-ply flush wood veneer-faced doors for transparent finish.
2. Solid-core five-ply flush wood doors for opaque finish.
3. Hollow-core flush wood veneer-faced doors for transparent finish.
4. Hollow-core flush wood doors for opaque finish.
5. Fire-rated wood door frames.
6. Light frames and louvers.

B. Product Data Submittals: For each product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Door trim for openings.
6. Door frame construction.
7. Factory-machining criteria.
8. Factory-priming specifications.

- C. Sustainable Design Submittals:
 - 1. Third-Party Certifications: For each product.
 - 2. Third-Party Certified Life Cycle Assessment: For each product.
 - 3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
- D. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
 - 1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
 - 2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
 - 3. Details of frame for each frame type, including dimensions and profile.
 - 4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 5. Dimensions and locations of blocking for hardware attachment.
 - 6. Dimensions and locations of mortises and holes for hardware.
 - 7. Clearances and undercuts.
 - 8. Requirements for veneer matching.
 - 9. Doors to be factory primed and application requirements.
 - 10. Apply AWI Quality Certification Program label to Shop Drawings.
- E. Samples for Initial Selection: For factory-finished doors and factory-finished door frames.
- F. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
 - 2. Polymer edging, in manufacturer's standard colors.
 - 3. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - 4. Louver blade and frame sections, 6 inches long, for each material and finish specified.
 - 5. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the door inspector.
 - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
 - 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
 - 3. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Special warranties.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.
- C. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
 - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install doors until spaces are enclosed and weather tight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors and frames.
3. Warranty Period for Solid-Core Exterior Doors: Five years from date of Substantial Completion.
4. Warranty Period for Solid-Core Interior Doors: Life of installation.
5. Warranty Period for Hollow-Core Interior Doors: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain flush wood doors from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.
 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS AND FRAMES, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Provide labels and certificates from AWI certification program indicating that doors and frames comply with requirements of grades specified.
 - a. Contractor registers the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 855-345-0991.
 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.
 3. Hardwood Plywood: 0.05 ppm.
 4. Particleboard: 0.09 ppm.
 5. MDF More Than 5/16 Inch Thick: 0.11 ppm.
 6. MDF 5/16 Inch or Less in Thickness: 0.13 ppm.
- 2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS AND TRANSOM PANELS FOR TRANSPARENT FINISH
- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Wilsonart LLC
 2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty and Standard Duty.
 3. Performance Grade by Location:
 - a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Apartment entry, public toilets, janitor's closets, assembly spaces, exits and where indicated on Drawings.
 - b. ANSI/WDMA I.S. 1A Standard Duty: Closets (not including janitor closets), private toilets and where indicated on Drawings.
 4. ANSI/WDMA I.S. 1A Quality Grade: Custom.
 5. Architectural Woodwork Standards Quality Grade: Custom.
 6. Faces: Single-ply wood veneer not less than 1/50 inch thick.
 - a. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 - b. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - c. Room Match:
 - 1) Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
 - 2) Provide door faces of compatible color and grain within each separate room or area of building.
 7. Exposed Vertical and Top Edges: Same species as faces or a compatible species -

Architectural Woodwork Standards edge Type A.

- a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - b. Fire-Rated Pairs of Doors:
 - 1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - 2) Provide formed-steel edges and astragals with intumescent seals.
 - a) Finish steel edges and astragals with baked enamel same color as doors.
 - b) Finish steel edges and astragals to match door hardware (locksets or exit devices).
 - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.
8. Core for Non-Fire-Rated Doors:
- a. ANSI A208.1, Grade LD-2 particleboard.
 - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087111 "Door Hardware (Descriptive Specification."
 - b. Glued wood stave.
 - c. WDMA I.S. 10 structural composite lumber.
 - 1) Screw Withdrawal, Door Face: 550 lbf.
 - 2) Screw Withdrawal, Vertical Door Edge: 550 lbf.
 - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
9. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
- a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.

10. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS AND TRANSOM PANELS FOR OPAQUE FINISH

A. Exterior Doors, Solid-Core Five-Ply for Opaque Finish:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lambton Doors
 - b. Oshkosh Door Company
 - c. VT Industries, Inc.
2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty and Standard Duty.
3. ANSI/WDMA I.S. 1A Quality Grade: Custom.
4. Architectural Woodwork Standards Quality Grade: Custom.
5. Faces: Any closed-grain hardwood of mill option.
6. Exposed Vertical and Top Edges: Any closed-grain hardwood.
7. Core:
 - a. ANSI A208.1, Grade LD-2 particleboard.
 - b. Glued wood stave.
 - c. WDMA I.S. 10 structural composite lumber.
 - 1) Screw Withdrawal, Door Face: 550 lbf.
 - 2) Screw Withdrawal, Vertical Door Edge: 550 lbf.
 - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
8. Construction: Five plies, hot-pressed, bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.
9. Adhesives: Type I in accordance with WDMA T.M. 6.

B. Interior Doors, Solid-Core Five-Ply for Opaque Finish:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lambton Doors
 - b. Oshkosh Door Company
 - c. VT Industries, Inc.
2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty and Standard Duty.
3. Performance Grade by Location:

- a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Apartment Entry, public toilets, janitor's closets, assembly spaces, exits and where indicated on Drawings.
- b. ANSI/WDMA I.S. 1A Standard Duty: Closets (not including janitor's closets) and private toilets and where indicated on Drawings.
- 4. Architectural Woodwork Standards Quality Grade: Custom.
- 5. Faces: Any closed-grain hardwood of mill option.
- 6. Exposed Vertical and Top Edges: Any closed-grain hardwood.
 - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - b. Fire-Rated Pairs of Doors:
 - 1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - 2) Provide formed-steel edges and astragals with intumescent seals.
 - a) Finish steel edges and astragals with baked enamel same color as doors.
 - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.
- 7. Core for Non-Fire-Rated Doors:
 - a. ANSI A208.1, Grade LD-2 particleboard.
 - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087111 "Door Hardware (Descriptive Specification."
 - b. Glued wood stave.
 - c. WDMA I.S. 10 structural composite lumber.
 - 1) Screw Withdrawal, Door Face: 550 lbf.
 - 2) Screw Withdrawal, Vertical Door Edge: 550 lbf.
 - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
- 8. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on

Drawings.

- a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
9. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.6 FIRE-RATED WOOD DOOR FRAMES

A. Interior Fire-Rated Door Frames:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lambton Doors
 - b. Masonite Architectural
 - c. Oshkosh Door Company
2. Architectural Woodwork Standards Quality Grade: Premium.
3. Wood Species and Cut: Match species and cut indicated for wood doors unless otherwise indicated.
4. Profile: Flat.
5. Construction: Solid lumber, fire-retardant particleboard, or fire-retardant medium density fiberboard (MDF) with veneered exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated on Drawings.

2.7 LIGHT FRAMES AND LOUVERS

- A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; factory primed for painted finish; and approved for use in doors of fire-protection rating indicated on Drawings.
- B. Metal Louvers:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allegion plc
 - b. ASSA ABLOY
 - c. JL Industries; Activar Construction Products Group, Inc.
 2. Blade Type: Vision-proof, inverted V or Vision-proof, inverted Y.

3. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.
- C. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allegion plc
 - b. ASSA ABLOY
 - c. JL Industries; Activar Construction Products Group, Inc.
 2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

2.8 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
 1. Locate hardware to comply with DHI-WDHS-3.
 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
 5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
 3. Louvers: Factory install louvers in prepared openings.
- D. Exterior Doors: Factory treat exterior doors with water repellent after fabrication has been completed but before factory priming.
 1. Flash top of outswinging doors with manufacturer's standard metal flashing.

2.9 FACTORY PRIMING

- A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.10 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
 - 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 2. Finish faces, all four edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated on Drawings to receive transparent finish.
- C. Factory finish doors where indicated in schedules or on Drawings as factory finished.
- D. Transparent Finish:
 - 1. Architectural Woodwork Standards Grade: Custom.
 - a. System-10, UV Curable, Water Based.
 - 2. Staining: As selected by Architect from manufacturer's full range.
 - 3. Sheen: Satin.
- E. Opaque Finish:
 - 1. Architectural Woodwork Standards Grade: Custom.
 - a. System-10, UV Curable, Water Based.
 - 2. Color: As selected by Architect from manufacturer's full range.
 - 3. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087111 "Door Hardware (Descriptive Specification)."
- B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
 - 1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
 - 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
 - 3. Install fire-rated doors and frames in accordance with NFPA 80.
 - 4. Install smoke- and draft-control doors in accordance with NFPA 105.
- D. Job-Fitted Doors:
 - 1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 - 2. Machine doors for hardware.
 - 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 4. Clearances:
 - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
 - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - d. Comply with NFPA 80 for fire-rated doors.
 - 5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 - 6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Owner.
- B. Inspections:
 - 1. Provide inspection of installed Work through AWI's Quality Certification Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WI's "Architectural Woodwork Standards" for the specified grade.
 - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 087111 - DOOR HARDWARE (DESCRIPTIVE SPECIFICATION)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinges.
2. Bored locks.
3. Mortise locks.
4. Bored auxiliary locks.
5. Mortise auxiliary locks.
6. Delayed-egress electromagnetic locks.
7. Exit devices and auxiliary items.
8. Lock cylinders.
9. Surface closers.
10. Wall- and floor-mounted stops.
11. Door gasketing.
12. Thresholds.
13. Metal protective trim units.
14. Auxiliary door hardware.

B. Related Requirements:

1. Section 081416 "Flush Wood Doors" for astragals and integral intumescent seals provided as part of labeled fire-rated assemblies.
2. Section 102600 "Wall and Door Protection" for plastic door protection units that match wall protection units.

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for allowance to be applied to applicable doors.

1.3 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field-verify

existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Conference participants must include Installer's Architectural Hardware Consultant and Owner's security consultant.
- B. Keying Conference: Conduct conference at Project site.
 - 1. Conference participants must include Installer's Architectural Hardware Consultant and Owner's security consultant.
 - 2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system, including, but not limited to, the following:
 - a. Flow of traffic and degree of security required.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
 - 1. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- D. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of product data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of

- other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.
- E. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC).

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
 - b. Exit Devices: Two years from date of Substantial Completion.

- c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested in accordance with UL 1784 and installed in compliance with NFPA 105.
 - 1. Air-Leakage Rate: Maximum air leakage of 0.3 cfm per sq. ft. at the tested pressure differential of 0.3 inch wg of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" the ABA standards of the Federal agency having jurisdiction HUD's "Fair Housing Accessibility Guidelines".
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.

4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 HINGES

- A. Hinges: ANSI/BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hager Companies
 - b. McKinney Products Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
 - c. STANLEY; dormakaba USA, Inc.

- B. Antifriction-Bearing Hinges:

1. Mounting: Full mortise (butts).
2. Bearing Material: Manufacturer's standard antifriction bearing.
3. Grade 2 (standard weight).
4. Base and Pin Metal:
 - a. Exterior Hinges: Stainless steel with stainless steel pin.
 - b. Interior Hinges: Steel with steel pin.
 - c. Hinges for Fire-Rated Assemblies: Steel with steel pin.
5. Pins: Nonremovable.
6. Tips: Flat button.
7. Corners: Square.

2.4 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
1. Bored Locks: Minimum 1/2-inch latchbolt throw.
 2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
 3. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: As indicated on Drawings.
2. Levers: Forged or Cast.
 - a. Construction: Freewheeling vandal-resistant.
3. Escutcheons (Roses): Forged or Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: ANSI/BHMA A156.2, Grade 1, Series 4000.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BEST Access Solutions, Inc.; dormakaba USA Inc.
 - b. Hager Companies
 - c. SARGENT Manufacturing Company; ASSA ABLOY
 - d. STANLEY; dormakaba USA, Inc.

G. Mortise Locks: ANSI/BHMA A156.13, Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BEST Access Solutions, Inc.; dormakaba USA Inc.
 - b. Hager Companies
 - c. SARGENT Manufacturing Company; ASSA ABLOY
 - d. [STANLEY; dormakaba USA, Inc.

2.5 AUXILIARY LOCKS

A. Bored Auxiliary Locks: ANSI/BHMA A156.36, Grade 1; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BEST Access Solutions, Inc.; dormakaba USA Inc.
 - b. Hager Companies
 - c. SARGENT Manufacturing Company; ASSA ABLOY
 - d. STANLEY; dormakaba USA, Inc.
2. Backset: 2-3/4 inches.
3. Material: Stainless steel.
4. Deadlatches: Deadlocking latchbolt operated by key as indicated on drawings.
5. Deadlocks: Deadbolt operated by key as indicated on drawings.

B. Mortise Auxiliary Locks: ANSI/BHMA A156.36, Grade 1; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BEST Access Solutions, Inc.; dormakaba USA Inc.
 - b. Hager Companies
 - c. SARGENT Manufacturing Company; ASSA ABLOY
 - d. STANLEY; dormakaba USA, Inc.
2. Backset: 2-3/4 inches.
3. Material: Stainless steel.
4. Deadlocks: Deadbolt operated by key as indicated on drawings.
5. Deadlatches: Latchbolt and auxiliary deadlatch operated by key as indicated on drawings.

2.6 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks: Surface mounted; battery powered, housed in metal case; with manufacturer's standard strike that suits frame; with red-and-white lettering reading "EMERGENCY EXIT PUSH TO OPEN - ALARM WILL SOUND."

1. Activated by horizontal bar.
2. Features:
 - a. Low-battery alert.
 - b. Outside key control.
 - c. Audible alarm that sounds when unauthorized use of door occurs.
 - d. Silent alarm with remote signal capability for connection to remote indicating panel.
 - e. Strike: Mortise.

B. Standalone Exit Alarms: Surface mounted on door.

1. Features:

- a. Low-battery alert.
- b. Outside key control.
- c. Audible alarm that sounds when unauthorized use of door occurs.
- d. Automatic rearming after authorized use, with adjustable time delay.
- e. Remote signal capability for connection to remote indicating panel.

2.7 MANUAL FLUSH BOLTS

- A. Manual-Extension Flush Bolts: Grade 1, fabricated from extruded brass or aluminum, with 12-inch rod actuated by flat lever.
 - 1. Strike: Dustproof.
 - 2. Fire Rated: Listed and labeled for use in fire-rated assemblies.
- B. Slide Flush Bolts: Grade 1, cast brass, with rod actuated by slide.
 - 1. Strike: Dustproof.
- C. Top-Bolt Extension Rod Length: As required to locate operating mechanism at not more than 72 inches above the finished floor at all times.
- D. Dustproof Strikes: Grade 1, polished wrought brass, with 3/4-inch- diameter, spring-tension plunger.

2.8 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

- A. Dustproof Strikes: Grade 1, polished wrought brass, with 3/4-inch- diameter, spring-tension plunger.

2.9 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: ANSI/BHMA A156.3.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. dormakaba USA Inc.
 - b. Hager Companies
 - c. SARGENT Manufacturing Company; ASSA ABLOY
 - d. STANLEY; dormakaba USA, Inc.
- B. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305.

- C. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing in accordance with UL 305 and NFPA 252.
- D. Surface Vertical-Rod Exit Devices: Grade 1.
 - 1. Type 2.
 - 2. Actuating Bar: Cross bar.
 - 3. Material: Stainless steel.
 - 4. Configuration: Top and bottom rods.
- E. Concealed Vertical-Rod Exit Devices: Grade 1.
 - 1. Type 7, for wood doors; Type 8, for metal doors.
 - 2. Actuating Bar: Cross bar.
 - 3. Material: Stainless steel.
 - 4. Configuration: Top and bottom rods.
- F. Exit Device Outside Trim: Lever with cylinder; material and finish to match locksets unless otherwise indicated.
 - 1. Match design for lock trim unless otherwise indicated.
- G. Through-Bolt Fasteners: For exit devices and trim on metal doors, non-fire-rated wood doors and fire-rated wood doors.

2.10 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BEST Access Solutions, Inc.; dormakaba USA Inc.
 - b. Hager Companies
 - c. SARGENT Manufacturing Company; ASSA ABLOY
 - d. STANLEY; dormakaba USA, Inc.
- B. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 1 permanent cores; face finished to match lockset.
 - 1. Core Type: Interchangeable.
 - 2. Number of Pins: Seven.
 - 3. Lock Type: Mortise or Bored-lock type as indicated on drawings.
- C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction

keys without cylinder removal. Provide 10 construction master keys.

- D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.11 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

- 1. Existing System:

- a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.

- 2. Keyed Alike: Key all cylinders to same change key.

- B. Keys: Nickel silver.

- 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

- a. Notation: "DO NOT DUPLICATE."

2.12 OPERATING TRIM

- A. Push-Pull Plates: With square corners, beveled edges, and raised integral lip; secured with exposed screws.

- 1. Thickness: 1/8 inch.
 - 2. Size: 3-1/2 inches wide by 15-3/4 inches high.

- B. Straight Pull-Plate Door Pulls: Pull fixed to 0.050-inch- thick plate, 4 inches wide by 16 inches high with square corners and beveled edges.

- 1. Type: 3/4-inch constant-diameter pull.
 - 2. Mounting: Surface applied with concealed fasteners.
 - 3. Minimum Pull Clearance: 1-1/2 inches from face of door.
 - 4. Overall Pull Length: 9 inches.

2.13 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: ANSI/BHMA A156.3; consisting of active-leaf, hold-open lever, and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.

- B. Carry-Open Bars: ANSI/BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Flat Overlapping Astragals: ANSI/BHMA A156.22; flat stainless steel metal bar, surface mounted on face of door with screws; minimum 1/8 inch thick by 2 inches wide by full height of door.
- D. Overlapping-with-Gasket Astragals: ANSI/BHMA A156.22; T-shaped metal, surface mounted on edge of door with screws.
 - 1. Base Metal: Stainless steel.
 - 2. Gasket Material: Polypropylene.

2.14 SURFACE CLOSERS

- A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. dormakaba USA Inc.
 - b. Hager Companies
 - c. SARGENT Manufacturing Company; ASSA ABLOY
 - d. STANLEY; dormakaba USA, Inc.
- B. Surface Closer with Cover: Grade 1; modern type with mechanism enclosed in cover.
 - 1. Backcheck: Adjustable, effective between 60 and 85 degrees of door opening.
 - 2. Cover Material: Plated steel.
 - 3. Closing Power Adjustment: At least 50 percent more than minimum tested value.

2.15 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16; polished cast-brass, -bronze, or -aluminum base metal.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ASI-American Specialties, Inc.

- b. Baldwin; part of the Spectrum Brands Hardware and Home Improvement Group (HHI)
 - c. Hager Companies
 - d. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
- B. Rigid-Type Floor Stop: Grade 1; with rubber bumper.
 - 1. Installation: Expansion-shield installation.
- C. Dome-Type Floor Stop: Grade 1; with minimum 1-inch- high bumper for doors without threshold and 1-3/8-inch- high bumper for doors with threshold.
 - 1. Provide with extruded-aluminum riser for carpet installations.
- D. Wall Bumpers: Grade 1; with rubber bumper; 2-1/2-inch diameter, minimum 3/4-inch projection from wall; with backplate for concealed fastener installation.
 - 1. Bumper Configuration: Concave.

2.16 DOOR GASKETING

- A. Door Gasketing: ANSI/BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hager Companies
 - b. National Guard Products, Inc
 - c. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
 - d. Reese Enterprises, Inc
- B. Maximum Air Leakage: When tested in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg, as follows:
 - 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
 - 2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
 - 3. Gasketing on Double Doors: 0.50 cfm per ft. of door opening.
- C. Adhesive-Backed Perimeter Gasketing: Silicone or Neoprene bulb gasket material applied to frame rabbet with self-adhesive.
- D. Overlapping Astragals for Meeting Stiles: EPDM strip gasket material held in place by housing and overlapping when doors are closed; mounted to face of meeting stile with screws.

1. Housing Material: Bronze.
 2. Mounting: Surface mounted on face of [each][one] door.
- E. Door Sweeps: Neoprene or Polyurethane gasket material held in place by flat housing or flange; surface mounted to face of door with screws.
1. Housing or Flange Material: Bronze.
- F. Door Shoes: Neoprene gasket material held in place by housing; mounted to bottom edge of door with screws.
1. Housing Material: Bronze.
 2. Extended Housing: One side of door.
 3. Mounting: Surface mounted on bottom edge of door.

2.17 THRESHOLDS

- A. Thresholds: ANSI/BHMA A156.21; fabricated to full width of opening indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hager Companies
 - b. National Guard Products, Inc
 - c. Pemko Manufacturing Company Inc.; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
 - d. Reese Enterprises, Inc
- B. Saddle Thresholds:
1. Type: Fluted top and offset or Thermal break and fluted top as indicated on drawings.
 2. Base Metal: Aluminum or Stainless steel.
- C. Ramped Thresholds: Modular, interlocking, sloped, fluted-top metal assemblies with closed return ends; 1:12 slope.
1. Top Surface: Fluted with slip-resistant abrasive.
 2. Base Metal: Aluminum or Extruded bronze.

2.18 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: ANSI/BHMA A156.6; fabricated from 0.050-inch- thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Hager Companies
- b. inpro Corporation
- c. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
- d. Trimco

B. Kick Plates: 8 inches high by door width with allowance for frame stops.

2.19 AUXILIARY DOOR HARDWARE

A. Auxiliary Door Hardware: ANSI/BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Baldwin; part of the Spectrum Brands Hardware and Home Improvement Group (HHI)
- b. Hager Companies
- c. Rockwood Manufacturing Company; ASSA ABLOY Accessories and Door Controls Group, Inc.; ASSA ABLOY
- d. Trimco

B. Garment Hooks: Grade 1; one long hat hook and one small coat hook; 3-3/4-inch projection from wall with 7-inch overall height; for surface-screw application.

1. Material: Burnished cast aluminum.

C. Door Knockers: Grade 1; solid brass with engraved number and nameplates.

D. Wide-Angle Door Viewers: Grade 1; solid brass with optical glass lenses; adjustable to door thickness and permitting one-way observation with minimum 190-degree viewing angle.

E. Fire-Rated Door Viewers: Solid brass with optical glass lenses; listed and labeled for use in fire-rated assemblies; adjustable to door thickness and permitting one-way observation with minimum 120-degree viewing angle.

F. Silencers for Wood Door Frames: Grade 1; neoprene or rubber; minimum 5/8 by 3/4 inch; fabricated for drilled-in application to frame.

G. Silencers for Metal Door Frames: Grade 1; neoprene or rubber; minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

2.20 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and

as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and ANSI/BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended; however, aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.21 FINISHES

- A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations

in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION OF DOOR HARDWARE

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every

30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- E. Key Control System:
 - 1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
 - 2. Key Lock Boxes: Install where indicated or approved by Owner to provide controlled access for fire and medical emergency personnel.
 - 3. Key Control System Software: Set up multiple-index system based on final keying schedule.
- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant is to examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service is to include 12 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies are to be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

- A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 DOOR HARDWARE SETS SCHEDULE

- A. Hardware Set 1: Each door to have the following:
 1. 3 Hinges.
 2. 1 Lockset F109
 3. 1 Door Closer
 4. 1 Threshold
 5. 1 Peephole
- B. Hardware Set 2: Each door to have the following:

1. 3 Hinges
2. 1 Lockset F 76

C. Hardware Set 3: Each door to have following:

1. 3 Hinges
2. 1 Latchset
3. 1 Door Closer
4. 1 Kick Plate
5. 1 Threshold
6. 1 Smoke Gasketing

D. Hardware Set 4: Each door to have following:

1. 3 Hinges
2. 1 Latchset
3. 1 Door Closer
4. 1 Kick Plate

E. Hardware Set 5: Each door to have following:

1. 3 Hinges
2. 1 Lockset F84

F. Hardware Set 6: Each door to have following:

1. 6 Hinges
2. 1 Latchset

G. Hardware Set 7: Each door to have following:

1. 3 Hinges
2. 1 Latchset

END OF SECTION 087111

SECTION 090190.52 - MAINTENANCE REPAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes maintenance repainting as follows:
 - 1. Patching substrates.
 - 2. Repainting.
- B. Related Requirements:
 - 1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.
 - 2. Section 099114 "Exterior Painting," and Section 099124 "Interior Painting," for painting materials and systems for new construction.

1.2 ALLOWANCES

- A. Allowances for maintenance repainting are specified in Section 012100 "Allowances."
 - 1. Perform maintenance repainting under quantity allowances and only as authorized. Authorized work includes work required by Drawings and Specifications and work as directed in writing by Owner.
 - 2. Notify Owner weekly of extent of work performed that is attributable to quantity allowances.
 - 3. Perform work that exceeds quantity allowances only as authorized by Change Orders.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.
- H. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.
- I. Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 SEQUENCING AND SCHEDULING

- A. Perform maintenance repainting in the following sequence, which includes work specified in this and other Sections:
 - 1. Dismantle existing surface-mounted objects and hardware except items indicated to remain in place. Tag items with location identification and protect.
 - 2. Verify that temporary protections have been installed.
 - 3. Examine condition of surfaces to be painted.
 - 4. Remove existing paint to the degree required for each substrate and surface condition of existing paint.
 - 5. Apply paint system.
 - 6. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for product application and use.
 - 2. Include test data substantiating that products comply with requirements.
- B. Sustainable Design Submittals:
- C. Samples: For each type of paint system and each pattern, color, and gloss; minimum 6 inches long in least dimension, but not less than whole pattern.
 - 1. Include stepped Samples defining each separate coat, including fillers and primers. Resubmit until each required sheen, color, and texture is achieved.
 - 2. For each painted color being matched to a standardized color-coding system, include the color chips from the color-coding-system company with Samples.
 - 3. Include a list of materials for each coat of each Sample.
 - 4. Label each Sample for location and application.
 - 5. Sample Size:
 - a. Painted Surfaces: 4-by-8-inch Samples for each color and material, on hardboard.

- b. Stained or Natural Wood: 12-by-12-inch Samples of natural- or stained-wood finish, on representative wood surfaces.

D. Product List: For each paint product indicated, include the following:

- 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
- 2. Printout of current "MPI Approved Products List" for each MPI-product category specified in paint systems, with the proposed product highlighted.
- 3. VOC content.

1.7 INFORMATIONAL SUBMITTALS

- A. Color Matching Certificate: For computer-matched colors.
- B. Preconstruction Test Reports: For cleaning materials, paint coatings and systems.

1.8 QUALITY ASSURANCE

- A. Color Matching: Custom computer-match paint colors to colors indicated on Drawings. For colors indicated by a standardized coding system, obtain a color chip for each color indicated from the color-coding-system company; computer match paint colors to the color chips.
- B. Mockups: Prepare mockups of maintenance repainting processes for each type of coating system and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.
 - 1. Locate mockups in locations that enable viewing under same conditions as the completed Work.
 - 2. Surface-Preparation Mockups: On existing surfaces using applicable specified methods of cleaning and other surface preparation, provide mockup sample of at least 100 sq. ft.
 - 3. Coating Mockups: Two surfaces of at least 100 sq. ft. to represent surfaces and conditions for application of each type of coating system under same conditions as the completed Work.
 - 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing of cleaning materials, compatibility of paint coatings and systems for each indicated type of painted surface.

1. Use test areas as indicated and representative of proposed materials and existing construction.
2. Propose changes to materials and methods to suit Project.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste daily.

1.11 FIELD CONDITIONS

- A. Weather Limitations: Proceed with maintenance repainting only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.
- B. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- C. Do not apply paint in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer for surface preparation and during paint application and drying periods.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F.
- C. Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent that contains no ammonia, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of warm water for every 5 gal. of solution required.
- D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup of household detergent that contains no ammonia, 1 quart of 5 percent sodium hypochlorite bleach, and 3 quarts of warm water.
- E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

2.2 PAINT REMOVERS

- A. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinseable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.

2.3 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from full range of industry colors.

2.4 PAINT MATERIALS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Clear Wood Finishes, Varnishes: 350 g/L.
 - 9. Clear Wood Finishes, Lacquers: 550 g/L.
 - 10. Floor Coatings: 100 g/L.
 - 11. Shellacs, Clear: 730 g/L.
 - 12. Shellacs, Pigmented: 550 g/L.
 - 13. Stains: 250 g/L.
 - 14. Flat Paints and Coatings: 50 g/L.
 - 15. Nonflat Paints and Coatings: 50 g/L.
 - 16. Dry-Fog Coatings: 150 g/L.
 - 17. Primers, Sealers, and Undercoaters: 100 g/L.
 - 18. Rust-Preventive Coatings: 100 g/L.
 - 19. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 20. Pretreatment Wash Primers: 420 g/L.
 - 21. Clear Wood Finishes, Varnishes: 275 g/L.
 - 22. Clear Wood Finishes, Lacquers: 275 g/L.
 - 23. Floor Coatings: 50 g/L.

24. Shellacs, Clear: 730 g/L.
 25. Shellacs, Pigmented: 550 g/L.
 26. Stains: 100 g/L.
 27. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 28. VOC content shall not exceed limits of authorities having jurisdiction and the following:
 - a. Flat Coatings: 50 g/L.
 - b. Nonflat Coatings: 100 g/L.
 - c. Nonflat - High-Gloss Coatings: 150 g/L.
 - d. Concrete/Masonry Sealers: 100 g/L.
 - e. Dry-Fog Coatings: 150 g/L.
 - f. Floor Coatings: 100 g/L.
 - g. Industrial Maintenance Coatings: 250 g/L.
 - h. Low-Solids Coatings: 120 g/L.
 - i. Mastic Texture Coatings: 100 g/L.
 - j. Metallic Pigmented Coatings: 500 g/L.
 - k. Pretreatment Wash Primers: 420 g/L.
 - l. Primers, Sealers, and Undercoaters: 100 g/L.
 - m. Reactive Penetrating Sealers: 350 g/L.
 - n. Recycled Coatings: 250 g/L.
 - o. Rust-Preventive Coatings: 250 g/L.
 29. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 30. VOC content shall not exceed limits of authorities having jurisdiction and the following:
 - a. Flat Coatings: 50 g/L.
 - b. Nonflat Coatings: 100 g/L.
 - c. Primers, Sealers, and Undercoats: 100 g/L.
 - d. Floor Coatings: 100 g/L.
 - e. Shellacs, Clear: 730 g/L.
 - f. Shellacs, Pigmented: 550 g/L.
 - g. Stains: 250 g/L.
 - h. Clear Wood Finishes (Varnishes, Sanding Sealers, and Lacquers): 275 g/L.
 31. Interior Flat Latex Wall Paint: 50 g/L.
 32. Interior Nonflat Latex Wall Paint: 150 g/L.
- B. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

2.5 PAINT MATERIALS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore & Co.
 - 2. Sherwin-Williams
 - 3. BEHR Paint Company

2.6 PATCHING MATERIALS

- A. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated from weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Repair Technology, Inc.
 - b. Polymeric Systems, Inc.; PPG Industries, Inc.
 - c. Protective Coating Company
- B. Metal-Patching Compound: Two-part, polyester-resin, metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated from corrosion. Filler shall be capable of filling deep holes and spreading to feather edge.
- C. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and traffic, the detail of work, and site conditions.
- D. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C842 and manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces

that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless the solutions will not damage adjacent surfaces. Use protective materials that are UV resistant and waterproof. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
3. Neutralize and collect alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.2 MAINTENANCE REPAINTING, GENERAL

- A. Maintenance Repainting Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at 5 feet away from painted surface and from building exterior at 20 feet away from painted surface.
- B. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:
 1. Remove failed coatings and corrosion and repaint.
 2. Verify that substrate surface conditions are suitable for repainting.
 3. Allow other trades to repair items in place before repainting.
- C. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.
- D. Heat Processes: Do not use torches, heat guns, or heat plates.

3.3 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of painting work. Comply with paint manufacturer's written instructions for inspection.
- B. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

1. If existing surfaces cannot be prepared to an acceptable condition for proper finishing by using specified surface-preparation methods, notify Architect in writing.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.4 PREPARATORY CLEANING

- A. General: Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.
- B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.
- C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.
- D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.
- E. Chemical Rust Removal:
 1. Remove loose rust scale with specified abrasives for ferrous-metal cleaning.
 2. Apply rust remover with brushes or as recommended in writing by manufacturer.
 3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
 4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
 5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
 6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.
- F. Mechanical Rust Removal:
 1. Remove rust with specified abrasives for ferrous-metal cleaning. Clean to bright metal.
 2. Wipe off residue with mineral spirits and either steel wool or soft rags.

3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.5 PAINT REMOVAL

- A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.
1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
 - a. Apply materials to all surfaces, corners, contours, and interstices, to provide a uniform final appearance without streaks.
 - b. After work is complete, remove protection no longer required. Remove tape and adhesive marks.
 2. Brushes: Use brushes that are resistant to chemicals being used.
 - a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.
 - b. Wood Substrates: Do not use wire brushes.
 3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.
 - a. Equip units with pressure gages.
 - b. Unless otherwise indicated, hold spray nozzle at least 6 inches from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
 - c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with nozzle having a cone-shaped spray.
 - d. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
 - e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.
- B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material.

3.6 SUBSTRATE REPAIR

- A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.

B. Wood Substrate:

1. Repair wood defects including dents and gouges more than 1/8 inch in size and all holes and cracks by filling with wood-patching compound and sanding smooth. Reset or remove protruding fasteners.
2. Where existing paint is allowed to remain, sand irregular buildup of paint, runs, and sags to achieve a uniformly smooth surface.

C. Cementitious Material Substrate:

1. General: Repair defects including dents and chips more than 1/4 inch in size and all holes and cracks by filling with cementitious patching compound and sanding smooth. Remove protruding fasteners.
2. New and Bare Plaster: Neutralize surface of plaster with mild acid solution as recommended in writing by paint manufacturer. In lieu of acid neutralization, follow manufacturer's written instruction for primer or transition coat over alkaline plaster surfaces.
3. Concrete, Cement Plaster, and Other Cementitious Products: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. If surfaces are too alkaline to paint, correct this condition before painting.

D. Gypsum-Plaster and Gypsum-Board Substrates:

1. Repair defects including dents and chips more than 1/8 inch in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.

E. Metal Substrate:

1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use mechanical rust removal method to clean off rust.
2. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

3.7 PAINT APPLICATION, GENERAL

- A. Comply with manufacturers' written instructions for application methods unless otherwise indicated in this Section.
- B. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.
- C. Apply a transition coat over incompatible existing coatings.
- D. Metal Substrate: Stripe paint corners, crevices, bolts, welds, and sharp edges before applying

full coat. Apply two coats to surfaces that are inaccessible after completion of the Work. Tint stripe coat different than the main coating and apply with brush.

- E. Blending Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

3.8 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.9 SURFACE-PREPARATION SCHEDULE

- A. General: Before painting, prepare surfaces where indicated on Drawings for painting according to applicable requirements specified in this schedule.
 - 1. Examine surfaces to evaluate each surface condition according to paragraphs below.
 - 2. Where existing degree of soiling prevents examination, preclean surface and allow it to dry before making an evaluation.
 - 3. Repair substrate defects according to "Substrate Repair" Article.

END OF SECTION 090190.52

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonstructural steel framing.
 - 2. Grid suspension systems.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of nonstructural steel framing and fastening and anchorage details.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, and attachments to adjoining work.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For code-compliance certification of studs and track.
- B. Evaluation Reports: From an agency acceptable to authorities having jurisdiction showing compliance with Project requirements, for the following:
 - 1. Studs and track.
 - 2. Equivalent corrosion-resistant coating on steel framing.
 - 3. Firestop track.
 - 4. Post-installed anchors.
 - 5. Power-actuated fasteners.

1.5 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Track: Provide documentation that framing members are certified in accordance with product-certification program of the Steel Stud

Manufacturers Association.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Protect materials from corrosion, deformation, and other damage during delivery, storage, and handling in accordance with AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Where indicated on Drawings, provide assemblies incorporating nonstructural steel framing identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: Where indicated on Drawings, provide assemblies incorporating nonstructural framing identical to those of assemblies tested in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.2 NONSTRUCTURAL STEEL FRAMING

- A. Framing Members, General: Comply with requirements in AISI S220 for conditions indicated on Drawings.
 - 1. Protective Coating: ASTM A653/A653M, G40 or coating with demonstrated equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Equivalent Corrosion-Resistant Coating: Evaluation report acceptable to authorities having jurisdiction demonstrates corrosion resistance equivalent to specified protective coating.
- B. Studs and Track: Conventional members, roll-formed into standard shapes without surface deformations to stiffen framing members.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich
 - b. Jaimes Industries, Inc.
 - c. MBA Metal Framing
 - 2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal

- deflection.
- 3. Minimum Yield Strength: 33 ksi.
- 4. Depth: As indicated on Drawings.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated on Drawings.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich
 - b. Jaimes Industries, Inc.
 - c. MRI Steel Framing, LLC
 - 2. Minimum Base-Steel Thickness: As indicated on Drawings.
- D. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: Asymmetrical or.

2.3 GRID SUSPENSION SYSTEMS

- A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries
 - b. CertainTeed; SAINT-GOBAIN
 - c. USG Corporation

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Adjustable Wall-Furring Brackets: ASTM A653/A653M G40 hot-dip galvanized steel sheet in minimum 0.0329-inch- base-steel thickness with serrated edges for attaching furring channels to exterior masonry or concrete walls.
- C. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.

1. Adjustable Wall-Furring Brackets for Tie Wire: Use minimum double strand of 0.0625-inch- diameter wire, or triple strand of 0.0475-inch- diameter wire to attach furring channels.
 2. Suspended-Ceiling Systems:
 - a. Splicing Carrying Channels and Furring Members: Use double loops of minimum 0.0625-inch- diameter wire.
 - b. Saddle Tying Main Runners and Cross Furring: Use minimum 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.
- D. Power-Actuated Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.162 inch in diameter.
- F. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, substrates, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 1. Furnish concrete inserts and other devices required to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION OF NONSTRUCTURAL METAL FRAMING, GENERAL

- A. Installation Standard: ASTM C754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to

framing installation.

- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF NONSTRUCTURAL STEEL FRAMING

- A. Install framing system components at spacings indicated on Drawings, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated on Drawings.
 - 2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated on Drawings.
 - 3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated on Drawings.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install track at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated on Drawings to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated on Drawings.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure unless otherwise indicated on Drawings.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated on Drawings. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated on Drawings and support closures to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Install to maintain continuity of fire-resistance-rated assembly indicated on Drawings.
 5. STC-Rated Partitions: Install framing to comply with STC-rated assembly indicated on Drawings.
- E. Direct Furring:
1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Shaped Furring Members:
1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- G. Suspended Assemblies: Isolate suspension assemblies from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
1. Hangers: Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system spaced as indicated on Drawings.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

- c. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - d. Do not attach hangers to steel roof deck.
 - e. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - f. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - g. Do not connect or suspend framing from ducts, pipes, or conduit.
 - 2. Carrying Channels (Main Runners): U-channels spaced as indicated on Drawings.
 - 3. Furring Channels (Furring Members): As indicated on Drawings.
 - a. Spacing: As indicated on Drawings.
 - b. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
 - 4. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
 - H. Installation Tolerances for Nonstructural Steel Framing:
 - 1. Framing Members: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.
 - 2. Suspended Assemblies: Install suspension systems that are level to within 1/8 inch in 12 ft. measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
- 3.5 INSTALLATION OF GRID SUSPENSION SYSTEMS
- A. Grid Suspension Systems: Install in accordance with manufacturer's written instructions. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
 - B. Installation Tolerances for Grid Suspension Systems: Install suspension systems that are level to within 1/8 inch in 12 ft. measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for nonstructural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Locations and installation of control and expansion joints, including plans, elevations, sections, and attachment details.

1.3 MOCKUPS

A. Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

- a. Each level of gypsum board finish required for use in exposed locations.
- b. Each texture finish required.

2. Apply or install final decoration required, including painting and wallcoverings, on exposed surfaces for review of mockups.

3. Simulate finished lighting conditions for review of mockups.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather,

condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings in accordance with ASTM E119; tested by a qualified testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings in accordance with ASTM E90 and classified in accordance with ASTM E413; tested by a qualified testing agency.

2.3 GYPSUM BOARD, GENERAL

- A. Size: Provide panel products in maximum lengths and widths available that will minimize joints in each area and that correspond with support system specified or indicated on Drawings.

2.4 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers

offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American Gypsum
- b. CertainTeed; SAINT-GOBAIN
- c. Georgia-Pacific Gypsum LLC
- d. USG Corporation

2. Thickness: As indicated on Drawings.
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

B. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American Gypsum
- b. CertainTeed; SAINT-GOBAIN
- c. Georgia-Pacific Gypsum LLC
- d. USG Corporation

2. Thickness: As indicated on Drawings.
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Gypsum Board, Type C: ASTM C1396/C1396M; manufactured to have increased fire-resistive capability.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American Gypsum
- b. CertainTeed; SAINT-GOBAIN
- c. Georgia-Pacific Gypsum LLC
- d. USG Corporation

2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
4. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American Gypsum
- b. CertainTeed; SAINT-GOBAIN

- c. Georgia-Pacific Gypsum LLC
 - d. USG Corporation
 - 2. Thickness: As indicated on Drawings.
 - 3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- E. Mold-Resistant Gypsum Board: ASTM C1396/C1396M; manufactured with moisture- and mold-resistant core and paper surfaces.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum
 - b. CertainTeed; SAINT-GOBAIN
 - c. Georgia-Pacific Gypsum LLC
 - d. USG Corporation
 - 2. Core: 1/2-inch, regular type.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
 - 4. Long Edges: Tapered.
- F. Glass-Mat Interior Gypsum Board: ASTM C1658/C1658M; manufactured with fiberglass mat laminated to both sides and designed for interior use.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Georgia-Pacific Gypsum LLC
 - c. USG Corporation
 - 2. Core: As indicated on Drawings.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
 - 4. Long Edges: Tapered.

2.5 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed; SAINT-GOBAIN
 - b. Georgia-Pacific Gypsum LLC

- c. USG Corporation
 - 2. Core: As indicated on Drawings.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
- B. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M, with manufacturer's standard edges.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Gypsum
 - b. CertainTeed; SAINT-GOBAIN
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company
 - 2. Core: As indicated on Drawings.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
- 1. Material: Galvanized-steel sheet or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M requirements.
- 1. Mold-Resistant Joint Compound: Use mold-resistant formulations with mold-resistant panel products.
- B. Joint Tape:
- 1. Interior Gypsum Board: Paper.
 - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 3. Tile Backing Panels: As recommended in writing by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended in writing by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended in writing by backing panel manufacturer.
2. Cementitious Backer Units: As recommended in writing by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.8 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended in writing by manufacturer for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise specified or indicated on Drawings.
 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended in writing by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers as follows:
 1. Non-Fire-Resistance-Rated Assemblies: Glass or slag or rock wool.
 2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

- F. Primer: As recommended in writing by textured finish manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840 requirements.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 requirements and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Gypsum Wallboard: As indicated on Drawings.
 - 2. Gypsum Board, Type X: Where required for fire-resistance-rated assembly.
 - 3. Lightweight Gypsum Board, Type X: .
 - 4. Gypsum Ceiling Board: As indicated on Drawings.
 - 5. Foil-Backed Gypsum Board: As indicated on Drawings.
 - 6. Abuse-Resistant Gypsum Board: As indicated on Drawings.
 - 7. Impact-Resistant Gypsum Board: As indicated on Drawings.
 - 8. Mold-Resistant Gypsum Board: As indicated on Drawings.
 - 9. Glass-Mat Interior Gypsum Board: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated on Drawings.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise specified or indicated on Drawings or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated on Drawings or required by fire-resistance-rated assembly.
 - 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated on Drawings or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over studs or furring members and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated on Drawings or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLATION OF TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated on Drawings. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Water-Resistant Backing Board: Install where indicated with 1/4-inch gap where panels abut other construction or penetrations.
- C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 APPLICATION OF JOINT TREATMENT MATERIALS

- A. Finishing Panel Products: Treat joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare panel surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over panel joints, except for trim products specifically indicated as not intended to receive tape.
- D. Interior Gypsum Board: Finish panels to levels indicated below and in accordance with ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 4. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Glass-Mat Faced Panels: Finish in accordance with manufacturer's written instructions.

3.6 PROTECTION

- A. Protect adjacent surfaces from joint compound and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during gypsum board installation and finishing.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Acoustical panels.
 - 2. Metal suspension system.
 - 3. Metal edge moldings and trim.
- B. Related Requirements:
- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Delegated Design Submittals: For seismic restraints for ceiling systems.
 - 1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension-system members.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.

5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
 - a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Access panels.
 - f. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.

- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Build mockup of typical ceiling area as indicated on Drawings.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized

moisture content.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations for Ceiling System: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A in accordance with ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

- A. Acoustical Panels:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited

to, the following:

- a. Armstrong World Industries
 - b. CertainTeed; SAINT-GOBAIN
 - c. USG Corporation
2. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
 3. Classification: Provide panels as follows:
 - a. Type and Form, Type III: Mineral base with painted finish; Form 4, cast or molded.
 - b. Type and Form, Type XX: High-density, ceramic- and mineral-base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
 - c. Pattern: as indicated by manufacturer's designation.
 4. Color: White.
 5. Edge/Joint Detail: Square.
 6. Thickness: As indicated on Drawings.
 7. Modular Size: As indicated on Drawings.
 8. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

A. Exposed Metal Suspension System:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries
 - b. CertainTeed; SAINT-GOBAIN
 - c. USG Corporation
2. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.
 - a. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.
3. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch- wide metal caps on

flanges.

- a. Fire Rating: As indicated on Drawings.
 - b. Structural Classification: Intermediate-duty system.
 - c. End Condition of Cross Runners: Override (stepped) butt-edge type.
 - d. Face Design: Flat, flush.
 - e. Cap Material: Cold-rolled steel or.
 - f. Cap Finish: Painted white.
4. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 9/16-inch- wide metal caps on flanges.
- a. Structural Classification: Intermediate-duty system.
 - b. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - c. Face Design: Flat, flush.
 - d. Cap Material: Cold-rolled steel.
 - e. Cap Finish: Painted white.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled bonded anchors.
 - b. Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633, Class SC 1 (mild) service condition.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing in accordance with ASTM E1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
 3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
 4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM

C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.

- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- F. Hold-Down Clips: Manufacturer's standard hold-down.
- G. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
- H. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
- I. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Metal Edge Moldings and Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries
 - b. CertainTeed; SAINT-GOBAIN
 - c. USG Corporation
 - 2. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - a. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 - b. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

- A. Install acoustical panel ceilings in accordance with ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems in accordance with tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 7. Do not attach hangers to steel deck tabs.
 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 4. Install hold-down and seismic clips in areas indicated; space in accordance with panel manufacturer's written instructions unless otherwise indicated.
 - a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.
 5. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Periodic inspection during the installation of suspended ceiling grids in accordance with ASCE/SEI 7.
- B. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 - 1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and post-installed anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two post-installed anchors used to attach bracing wires to concrete and will test them for 440 bf of tension.
 - 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- C. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoplastic rubber base.
2. Rubber molding accessories.
3. Vinyl molding accessories.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for removing existing floor coverings.
2. Section 096519 "Resilient Tile Flooring" for modular resilient flooring.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to resilient base and accessory installation including, but not limited to, the following:
 - a. Delivery, storage, and handling procedures.
 - b. Ambient conditions and ventilation procedures.
 - c. Subfloor preparation procedures for resilient stair accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation instructions for each type of substrate.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For resilient base and accessory products, for tests performed by a qualified testing agency.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Furnish not less than 10 linear ft. for every 500 linear ft. or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.6 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been

completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical products in accordance with ASTM E648 or ASTM E662 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 RESILIENT BASE

- A. Thermoplastic Rubber Base:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong Flooring, Inc.
 - b. Roppe Corporation; Roppe Holding Company
 - c. Tarkett USA
2. Classification: ASTM F1861, Type TP (rubber, thermoplastic), Group I (solid, homogeneous).
3. Style and Location:
 - a. Style A, Straight: Provide in areas with carpet.
 - b. Style B, Cove: Provide in areas with resilient floor coverings.
 - c. Style C, Butt to: Provide in areas indicated.
4. Thickness: 0.125 inch.
5. Height: As indicated on Drawings.
6. Lengths: Coils in manufacturer's standard length.
7. Outside Corners: Job formed or preformed.
8. Inside Corners: Job formed or preformed.

2.3 RESILIENT MOLDING ACCESSORIES

- A. Rubber Molding Accessories :

1. Accessory Description: cap for cove carpet cap for cove resilient floor covering nosing for resilient floor covering reducer strip for resilient floor covering transition strips.
2. Profile and Dimensions: As indicated.

- B. Locations: Provide resilient molding accessories in areas indicated.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended in writing by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates in accordance with manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces in accordance with ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation

materials into spaces where they will be installed.

- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 INSTALLATION OF RESILIENT BASE

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from

construction operations and placement of equipment and fixtures during remainder of construction period.

- D. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply two coat(s).
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vinyl composition floor tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
 - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 2. Show details of special patterns.
- C. Samples: Full-size units of each color, texture, and pattern of floor tile required.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in

techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL COMPOSITION FLOOR TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Mannington, Shibori Jasmine - SX5W7800 or comparable product by one of the following:
 - 1. Armstrong Flooring
 - 2. Mohawk
 - 3. Shaw
- B. Tile Standard ASTM F1700, Class III, Type B.
- C. Thickness: 2.5-mm.
- D. Size: 5.91 by 39.37 inches.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099114 - EXTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Surface preparation of substrates and application of the following:
 - 1. Exterior paint systems.
- B. Related Requirements:
 - 1. Section 099124 "Interior Painting (MPI Standards)."

1.2 DEFINITIONS

- A. MPI Gloss Level G1: Not more than five units at 60 degrees and 10 units at 85 degrees, in accordance with ASTM D523.
- B. MPI Gloss Level G2: Not more than 10 units at 60 degrees and between 10 to 35 units at 85 degrees, in accordance with ASTM D523.
- C. MPI Gloss Level G3: Between 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, in accordance with ASTM D523.
- D. MPI Gloss Level G4: Between 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, in accordance with ASTM D523.
- E. MPI Gloss Level G5: Between 35 to 70 units at 60 degrees, in accordance with ASTM D523.
- F. MPI Gloss Level G6: Between 70 to 85 units at 60 degrees, in accordance with ASTM D523.
- G. MPI Gloss Level G7: More than 85 units at 60 degrees, in accordance with ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Include preparation requirements and application instructions.
 - 3. Indicate VOC content.
- B. Samples: For each type of topcoat product.

- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in applicable exterior painting schedule articles to cross-reference paint systems specified in this Section. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 MOCKUPS

- A. Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. The Owner will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each paint product from single source from single manufacturer.

2.2 EXTERIOR PAINTS, GENERAL

- A. MPI Standards: Provide products complying with MPI standards indicated in applicable exterior painting schedule articles and listed in the "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Cementitious Composition Board: 12 percent.
 - 3. Masonry (Clay and CMU): 12 percent.
 - 4. Wood: 15 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, have workers skilled in the trades involved reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view and remove sanding dust.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION OF EXTERIOR PAINT PRODUCTS

- A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in applicable exterior painting schedule articles may be omitted on items that are factory primed, or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.
 - 3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.

2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Owner, and leave in undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE, CONCRETE SUBSTRATES

- A. Vertical (Nontraffic) Surfaces:
1. Latex System: MPI EXT 3.1A.
 - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, low sheen (MPI Gloss Levels G3 and G4), MPI #15.
- B. Horizontal (Traffic) Surfaces:
1. Latex Zone/Traffic-Marking Paint System: MPI EXT 3.2E.
 - a. Traffic-marking paint, latex, MPI #97.

END OF SECTION 099114

SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Surface preparation of substrates and application of the following:
 - 1. Interior paint systems.

1.2 DEFINITIONS

- A. MPI Gloss Level G1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, in accordance with ASTM D523.
- B. MPI Gloss Level G2: Not more than 10 units at 60 degrees and between 10 to 35 units at 85 degrees, in accordance with ASTM D523.
- C. MPI Gloss Level G3: Between 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, in accordance with ASTM D523.
- D. MPI Gloss Level G4: Between 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, in accordance with ASTM D523.
- E. MPI Gloss Level G5: Between 35 to 70 units at 60 degrees, in accordance with ASTM D523.
- F. MPI Gloss Level G6: Between 70 to 85 units at 60 degrees, in accordance with ASTM D523.
- G. MPI Gloss Level G7: More than 85 units at 60 degrees, in accordance with ASTM D523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Include preparation requirements and application instructions.
 - 3. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat. Submit paint manufacturer's standard printed cards for verification Samples.
 - 1. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same

designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match paint products applied and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 MOCKUPS

- A. Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each paint product from single source from single manufacturer.

2.2 INTERIOR PAINTS, GENERAL

- A. Interior Paint Systems: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the applicable interior painting schedule articles for the paint category indicated.
- B. MPI Standards: Provide products complying with MPI standards indicated in applicable interior painting schedule articles and listed in the "MPI Approved Products List."
- C. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products must be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- D. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 50 g/L.
 - 3. Primers, Sealers, and Undercoaters: 100 g/L.
 - 4. Rust-Preventive Coatings: 100 g/L.
 - 5. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 6. Pretreatment Wash Primers: 420 g/L.
 - 7. Floor Coatings: 50 g/L.
 - 8. Shellacs, Clear: 730 g/L.
 - 9. Shellacs, Pigmented: 550 g/L.
- E. Colors: As indicated in a color schedule on Drawings.
 - 1. 20 percent of surface area will be painted with deep tones.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Cementitious Composition Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Wood: 15 percent.
 - 5. Gypsum Board: 12 percent. Verify that finishing compound is dry and sanded smooth.
- C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" or "MPI Maintenance Repainting Manual" as applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's

written instructions.

- F. Steel Substrates: Remove loose rust, loose mill scale, loose shop primer, and other loose foreign matter. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized Metal Substrates: Remove grease and oil residue from galvanized metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for interior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view and remove sanding dust.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION OF INTERIOR PAINT PRODUCTS

- A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in applicable interior painting schedule articles may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film

has a uniform paint finish, color, and appearance.

- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed to view in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Owner.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
 - 3. Cost of retesting is Contractor's responsibility.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 - 3. Allow empty paint cans to dry before disposal.
 - 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE, CONCRETE SUBSTRATES

- A. Vertical (Nontraffic) Surfaces:
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 3.1M.
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - b. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level G5), MPI #147.

3.7 INTERIOR PAINTING SCHEDULE, MASONRY SUBSTRATES

- A. Clay Masonry Substrates:
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 4.1M.
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - b. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level G5), MPI #147.
- B. CMU Substrates:
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 4.2E.
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

- b. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level G5), MPI #147.

3.8 INTERIOR PAINTING SCHEDULE, METAL SUBSTRATES

A. Steel and Iron Substrates:

- 1. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
 - a. Prime Coat: Primer, rust inhibitive, water based, MPI #107.
 - b. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level G6), MPI #148.

B. Galvanized Metal Substrates:

- 1. Institutional Low-Odor/VOC Latex System: MPI INT 5.3N.
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Topcoat: Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level G6), MPI #148.

3.9 INTERIOR PAINTING SCHEDULE, WOOD SUBSTRATES

A. Exposed Wood Framed Substrates:

- 1. Institutional Low-Odor/VOC Latex System: MPI INT 6.2L.
 - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
 - b. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level G5), MPI #147.

B. Finish Carpentry Substrates: Wood trim and Doors.

- 1. Institutional Low-Odor/VOC Latex System: MPI INT 6.3V.
 - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
 - b. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level G5), MPI #147.

C. Architectural Woodwork Substrates: Casework.

- 1. Institutional Low-Odor/VOC Latex System: MPI INT 6.4T.
 - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
 - b. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level G5), MPI #147.

3.10 INTERIOR PAINTING SCHEDULE, GYPSUM-BASED SUBSTRATES

A. Gypsum Board and Plaster Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - b. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (MPI Gloss Level G5), MPI #147.

END OF SECTION 099124

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.

1.2 ALLOWANCES

- A. Allowances for room-identification signs are specified in Section 012100 "Allowances."

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.

- E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample.
 - 2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 - 3. Exposed Accessories: Full-size Sample of each accessory type.
 - 4. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- F. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and the ABA standards of the Federal agency having jurisdiction.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 1. Manufacturers: Subject to compliance with requirements, use available local manufacturers offering products that meet product design requirements.
 2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: As indicated on Drawings.
 - b. Corner Condition in Elevation: As indicated on Drawings.
 3. Mounting: Manufacturer's standard method for substrates indicated.
 4. Text and Typeface: typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.
- E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - b. Fastener Heads: Use flathead or oval countersunk screws and bolts with tamper-resistant Allen-head or one-way-head slots unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.
- D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.
- E. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
 - 1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.
 - 2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.
 - 3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. Subsequent changeable sign panels are by Owner.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 4. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips **0.250 inch** away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean

condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Corner guards.

B. Related Requirements:

1. Section 087111 "Door Hardware (Descriptive Specification)" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of exposed plastic material.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-

ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
 - a. Store corner-guard covers in a vertical position.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities.

2.3 CORNER GUARDS

- A. Surface-Mounted, Transparent-Plastic Corner Guards: Fabricated as one piece from clear polycarbonate plastic sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Floor Products Company, Inc
 - b. Construction Specialties, Inc.
 - c. inpro Corporation
 - 2. Wing Size: Nominal 1-1/8 by 1-1/8 inches.
 - 3. Thickness: Minimum 0.075 inch.
 - 4. Mounting: Countersunk screws through factory-drilled mounting holes.

2.4 MATERIALS

- A. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D256, Test Method A.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Private-use bathroom accessories.

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 ALTERNATES

- A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.4 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.5 ACTION SUBMITTALS

- A. Product Data: For each product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Include electrical characteristics.
- B. Samples: For each exposed product and for each finish specified, full size.
 - 1. Approved full-size Samples will be returned and may be used in the Work.

- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.
- D. Delegated Design Submittals: For grab bars and shower seats.
 - 1. Include structural design calculations indicating compliance with specified structural-performance requirements.

1.6 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.8 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
 - 2. Shower Seats: Installed units are able to resist 360 lbf concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.
- B. Grab Bar:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc
 - c. Bradley Corporation
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 4. OD: 1-1/4 inches.
 - 5. Configuration and Length: As indicated on Drawings.

2.3 PRIVATE-USE BATHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of private-use bathroom accessory from single source from single manufacturer.
- B. Private-Use Shower Curtain Rod:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc
 - c. Bradley Corporation
 - 2. Description: 1-1/4-inch- OD, curved rod.
 - 3. Configuration: As indicated on Drawings.
 - 4. Mounting Flanges: Concealed fasteners; in manufacturer's standard material and finish.
 - 5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 7 finish (polished).
 - 6. Features: Integral chrome-plated brass glide hooks.
- C. Private-Use Folding Shower Seat:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers

offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc
 - c. Bradley Corporation
2. Configuration: L-shaped seat, designed for wheelchair access.
 3. Seat: Stainless steel, ASTM A480/A480M No. 4 finish (satin); 0.05-inch- minimum nominal thickness; with single-piece, pan-type construction and edge seams welded and ground smooth.
 4. Mounting Mechanism: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

D. Private-Use Towel Bar:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ASI-American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc
 - c. Bradley Corporation
2. Description: 3/4-inch- round tube with circular end brackets.
3. Mounting: Flanges with concealed fasteners.
4. Length: 24 inches.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 7 finish (polished).

2.4 CUSTODIAL ACCESSORIES

- A. Source Limitations: Obtain each type of custodial accessory from single source from single manufacturer.

2.5 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.6 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

PART 3 - EXECUTION

3.1 INSTALLATION OF TOILET, BATH, AND LAUNDRY ACCESSORIES

- A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

SECTION 105500.13 - USPS-DELIVERY POSTAL SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cluster box units.
2. Accessories.

B. Related Requirements:

1. Section 087111 "Door Hardware (Descriptive Specification)" for lock cylinders for postal specialties that are keyed to building keying system and for letter slots in doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of postal specialty.

B. Shop Drawings: For postal specialties.

1. Include plans, elevations, sections, and attachment details.
2. Include identification sequence for compartments.
3. Include layout of identification text.
4. Include setting drawings, templates, and installation instructions for anchor bolts and other anchorages installed as part of the Work of other Sections.

C. Samples for Verification: For each type of exposed finish, prepared on 6-by-6-inch square Samples.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of postal specialty required to comply with USPS regulations, signed by product manufacturer. Include written approval by Postmaster General.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For postal specialties and finishes to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Furnish lock keys according to USPS requirements; with temporary identification for their respective locks, bagged, and securely taped inside the collection compartment for shipping.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of postal specialties that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PARCEL LOCKERS

- A. Rear-Loading Parcel Lockers, Recessed: Consisting of single or multiple compartments enclosed within a recessed wall box. Provide access to compartments for distributing incoming parcels from rear of unit with accessibility to entire group of compartments. Provide access to each compartment for removing parcels by swinging compartment door. Comply with USPS-STD-4C.
 - 1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Eagle Mailbox Mfg. Corp.
 - b. Jayco Industries
 - c. Jensen Mailboxes Manufacturing Company
 - d. Postal Products Unlimited, Inc.
 - 2. Compartments: As indicated on Drawings, of the following sizes: As indicated on Drawings.
 - 3. Rear-Loading Cover: Lift-off rear cover fabricated from extruded aluminum or aluminum sheet, finished to match front of unit.
 - 4. Compartment Doors and Frames: Fabricated from[same material and finish as adjacent mail receptacles. Equip each compartment door with lock; identification; and concealed, full-length, spring-loaded, flush hinge on one side.

- a. Compartment Identification: Black, sequential numbers recess in face of compartment door.
 - b. Compartment-Door Locks: Dual-lock security system in which master lock provides access to customer lock (USPS-L-1172C) and parcel-locker key opens compartment and is retained once opened.
- 5. Exposed Aluminum Finish: Finish surfaces exposed to view as follows:
 - a. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

2.2 FABRICATION

- A. Form postal specialties to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of postal specialties to preclude binding, warping, or misalignment.
- B. Preassemble postal specialties in shop to greatest extent possible to minimize field assembly.
- C. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.
- D. Drill or punch holes required for fasteners and remove burrs. Use security fasteners where fasteners are exposed. If used, seal external rivets before finishing.
- E. Weld in concealed locations to greatest extent possible without distorting or discoloring exposed surfaces. Remove weld spatter and welding oxides from exposed surfaces.
- F. Fabricate tubular and channel frame assemblies with manufacturer's standard welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support loads.
- G. Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

2.3 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range

of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for roughing-in openings, clearances, and other conditions affecting performance of the Work.
- B. Examine walls and other adjacent construction for suitable conditions before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install postal specialties level and plumb, according to manufacturer's written instructions.
 - 1. Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturer.
 - 2. Where aluminum contacts grout, concrete, masonry, or wood, protect against corrosion by painting contact surfaces with bituminous coating.
 - 3. Final acceptance of postal specialties served by the USPS depends on compliance with USPS requirements.

3.3 FIELD QUALITY CONTROL

- A. Arrange for USPS personnel to examine and test postal specialties served by the USPS after they have been installed according to USPS regulations.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as postal specialties are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust doors, hardware, and moving parts to function smoothly, and lubricate as recommended by manufacturer. Verify that integral locking devices operate properly.
- C. Touch up marred finishes or replace postal specialties that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by postal-specialty manufacturer.

- D. Replace postal specialties that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- E. On completion of postal-specialty installation, clean interior and exterior surfaces as recommended by manufacturer.

END OF SECTION 105500.13

SECTION 113013 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cooking appliances.
2. Kitchen exhaust ventilation.
3. Refrigeration appliances.

B. Related Requirements:

1. Section 224000 "Plumbing Fixtures" for kitchen sinks, dishwasher air-gap fittings, waste (garbage) disposers, and instant hot-water dispensers.

1.2 ALLOWANCES

- A. Furnish residential appliances as part of residential appliance allowance.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

- B. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

- C. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.

- B. Product Certificates: For each type of appliance.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturers' special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.7 WARRANTY

- A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Electric Cooktop and Range: Full warranty, including parts and labor, for on-site service on surface-burner elements.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Microwave Oven: Full warranty, including parts and labor, for on-site service on the magnetron tube.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- D. Refrigerator/Freezer, Freezer, and Icemaker, Sealed System: Full warranty, including parts and labor, for on-site service on the product.
 - 1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
 - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.
- E. Dishwasher: Full warranty, including parts and labor, for on-site service on the product.
 - 1. Warranty Period for Deterioration of Tub and Metal Door Liner: Five years from date of Substantial Completion.
 - 2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain residential appliances from single source and each type of residential appliance from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design.

2.3 COOKING APPLIANCES

- A. Electric Cooktop:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GE Appliances; Haier Group
 - b. KitchenAid; Whirlpool Corporation
 - c. Thermador; BSH Home Appliances Corporation
 - 2. Width: as indicated on drawings.
 - 3. Electric Burner Elements: Four.
 - a. Induction Type: Manufacturer's standard.
 - 4. Controls: Digital panel controls, located on front.
 - 5. Electric Power Supply: As indicated on Drawings.
 - 6. Top Material: Manufacturer's standard.
 - a. Color/Finish: Black.
- B. Electric Range: Freestanding range with one oven(s) and complying with AHAM ER-1.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GE Appliances; Haier Group
 - b. KitchenAid; Whirlpool Corporation

- c. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC)
- 2. Width: as indicated on drawings.
- 3. Electric Burner Elements: as indicated on drawings.
- 4. Oven Features:
 - a. Capacity: as indicated on drawings.
 - b. Operation: as indicated on drawings.
- 5. Anti-Tip Device: Manufacturer's standard.
- 6. Electric Power Supply: As indicated on Drawings.
- 7. Material: Porcelain-enameled Stainless steel with manufacturer's standard cooktop.
 - a. Color/Finish: Black.

2.4 KITCHEN EXHAUST VENTILATION

A. Overhead Exhaust Hood:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GE Appliances; Haier Group
 - b. KitchenAid; Whirlpool Corporation
 - c. Thermador; BSH Home Appliances Corporation
- 2. Type: Wall-mounted, exhaust-hood system.
- 3. Dimensions:
 - a. Width: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
- 4. Exhaust Fan: Three-speed fan built into hood and with manufacturer's standard capacity.
 - a. Venting: Nonvented, recirculating type with charcoal filter.
 - b. Fan Control: Hood-mounted touch-pad to control fan switch, with separate hood-light control switch.
- 5. Finish: Stainless steel.
- 6. Features:
 - a. Permanent, washable stainless steel-mesh filter(s).
 - b. Built-in lighting.

2.5 REFRIGERATION APPLIANCES

- A. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on bottom and complying with AHAM HRF-1.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GE Appliances; Haier Group
 - b. KitchenAid; Whirlpool Corporation
 - c. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC)
 2. Type: Freestanding.
 3. Dimensions:
 - a. Width: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - c. Height: As indicated on Drawings.
 4. General Features:
 - a. Door Configuration: Overlay.
 - b. Dispenser in door for ice and cold water.
 - c. Built-in water-filtration system.
 - d. Dual refrigeration systems.
 - e. Separate temperature controls for each compartment.
 5. Refrigerator Features:
 - a. Interior light in refrigeration compartment.
 - b. Compartment Storage: vegetable crisper and meat compartment.
 - c. Door Storage: Modular compartments.
 - d. Temperature-controlled meat/deli bin.
 6. Freezer Features: One freezer compartment(s) configured as pull-out drawer(s).
 - a. Automatic defrost.
 - b. Interior light in freezer compartment.
 - c. Automatic icemaker and storage bin.
 7. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
 8. Front Panel(s): Manufacturer's standard.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable,

temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust hoods and microwave ovens with vented exhaust fans will be installed.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF RESIDENTIAL APPLIANCES

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and

components.

- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113013

SECTION 123530 - RESIDENTIAL CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Residential stock cabinets.

B. Related Requirements:

1. Section 123623.13 "Plastic-Laminate-Clad Countertops."
2. Section 123661 "Simulated Stone Countertops."

1.2 DEFINITIONS

- A. Concealed Surfaces of Casework: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of casework installed directly against and completely concealed by walls or other casework, and tops of wall cabinets and utility cabinets.
- B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.
- C. Semi-exposed Surfaces of Casework: Surfaces behind opaque doors or drawer fronts, including interior faces of doors, interiors and sides of drawers, and bottoms of wall cabinets.

1.3 COORDINATION

- A. Coordinate layout and installation of blocking and reinforcement in partitions for support of casework.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components, and profiles and finishes for casework.
2. Include rated capacities, operating characteristics, profiles, and finishes for hardware.

B. Shop Drawings:

1. Include plans, elevations, details, and attachments to other work.

- 2. Show materials, finishes, filler panels, and hardware.
 - 3. Indicate manufacturer's catalog numbers for casework.
- C. Samples: For casework and hardware finishes.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For casework.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.
- C. Field Measurements: Where casework is indicated to fit to other construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.
 - 1. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 RESIDENTIAL STOCK CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cabinet Craft LLC
 - 2. KraftMaid; Cabinetworks Group
 - 3. Lanz Cabinets Incorporated
 - 4. Merillat Cabinetry; Cabinetworks Group
- B. Quality Standard: Provide cabinets that comply with KCMA A161.1.
 - 1. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a

semi-exposed location of each unit and showing compliance with KCMA A161.1.

- C. Regional Materials: Verify the following wood products are manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If materials are transported by rail or water, multiply the distance by 0.25 to determine the distance to Project site.
- D. Door and Drawer Face Style: Flush overlay; faces cover cabinet fronts.
 - 1. Door and Drawer Fronts:
 - a. 1/2-inch- thick, plastic-laminate-faced particleboard.
- E. Cabinet Style: Frameless.
- F. Exposed Cabinet End Finish: Plastic laminate.
- G. Cabinet Tops and Bottoms: 5/8-inch- thick particleboard or 1/2-inch- thick plywood.
 - 1. Fully support in rabbets in and secure to end panels and back rail.
- H. Back, Top, and Bottom Rails: 3/4-by-2-1/2-inch solid wood, interlocking with end panels and rabbeted to receive top and bottom panels. Back rails secured under pressure with glue and with mechanical fasteners.
- I. Wall-Hung-Unit Back Panels: 3/16-inch- thick plywood fastened to rear edge of end panels and to top and bottom rails.
- J. Base-Unit Back Panels: 3/16-inch- thick plywood fastened to rear edge of end panels and to top and bottom rails.
- K. Front Frame Drawer Rails: 3/4-by-1-1/4-inch solid wood mortised and fastened into face frame.
- L. Drawers: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
 - 2. Subfronts, Backs, and Sides: 1/2-inch- thick solid wood or 3/8-inch- thick plywood.
 - 3. Bottoms: 1/4-inch- thick plywood.
- M. Shelves: 3/4-inch- thick particleboard or 5/8-inch- thick plywood.
- N. Joinery: Rabbet backs flush into end panels and secure with concealed mechanical fasteners. Connect tops and bottoms of wall cabinets and bottoms and stretchers of base cabinets to ends and dividers with mechanical fasteners. Rabbet tops, bottoms, and backs into end panels.
- O. Factory Finishing: Finish cabinets at factory.

2.2 CABINET MATERIALS

- A. Hardwood Lumber: Kiln dried to 7 percent moisture content.
- B. Softwood Lumber: Kiln dried to 10 percent moisture content.
 - 1. Hardwood Plywood: 0.05 ppm.
 - 2. Particleboard: 0.09 ppm.
 - 3. MDF More Than 5/16 Inch (8 mm) Thick: 0.11 ppm.
 - 4. MDF 5/16 Inch (8 mm) or Less in Thickness: 0.13 ppm.
- C. Hardwood Plywood: HPVA HP-1.
- D. Particleboard: ANSI A208.1, Grade M-2.
- E. MDF: Medium-density fiberboard, ANSI A208.2, Grade MD.
- F. Hardboard: ANSI A135.4, Class 1 tempered.
- G. Exposed Materials:
 - 1. Exposed Wood Species: Manufacturer's standard domestic hardwood species.
 - a. Select materials for compatible color and grain. Do not use two adjacent exposed surfaces that are noticeably dissimilar in color, grain, figure, or natural character markings.
 - b. Staining and Finish: As selected by Architect from manufacturer's full range.
 - 2. Solid Wood: Clear hardwood lumber of species indicated, free of defects.
 - 3. Plywood: Hardwood plywood with face veneer of species indicated, with Grade A faces and Grade C backs of same species as faces.
 - a. Edge band exposed edges with a minimum of 1/8-inch- thick, solid-wood edging of same species as face veneer.
 - 4. Plastic Laminate: Particleboard faced with high-pressure decorative laminate complying with ISO 4586, Grade VGS and edge-banded.
 - a. Colors, Textures, and Patterns: As selected by Architect from cabinet manufacturer's full range.
 - b. Plastic-Laminate Edge-banding: Of same grade, pattern, color, and texture of plastic laminate as for faces.
- H. Semi-exposed Materials: Unless otherwise indicated, provide the following:
 - 1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects. Same species as exposed surfaces or stained to be compatible with exposed surfaces.
 - 2. Plywood: Hardwood plywood with Grade C faces and not less than Grade 3 backs of same species as faces. Face veneers of same species as exposed surfaces or stained to

be compatible with exposed surfaces.

3. Plastic Laminate: Particleboard faced with high-pressure decorative laminate complying with ISO 4586, Grade VGS.

- a. For backs of doors and drawer fronts faced with plastic laminate, provide same grade, pattern, color, and texture of plastic laminate as for faces.
- b. For face frames faced with plastic laminate, provide plastic-laminate edges of same grade, pattern, color, and texture of plastic laminate as for faces.
- c. For shelves faced with plastic laminate, provide plastic-laminate edges of same grade, pattern, color, and texture of plastic laminate as for faces.
- d. Colors, Textures, and Patterns: As selected by Architect from cabinet manufacturer's full range.

- I. Concealed Materials: Solid wood or plywood, of any hardwood or softwood species, with no defects affecting strength or utility; particleboard; MDF; or hardboard.

2.3 CABINET HARDWARE

- A. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range.
- B. Pulls: Back-mounted decorative pulls with backing plates.
- C. Hinges: Concealed European-style, self-closing hinges.
- D. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or Type B05091.
- E. Door and Drawer Bumpers: Self-adhering, clear silicone rubber.
 1. Doors: Provide one bumper at top and bottom of closing edge of each swinging door.
 2. Drawers: Provide one bumper on back side of drawer front at each corner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of casework.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF RESIDENTIAL CASEWORK

- A. Install casework with no variations in adjoining surfaces; use concealed shims. Where casework abuts other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match casework.
- B. Install casework without distortion so doors and drawers fit the openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.
- C. Install casework level and plumb to a tolerance of 1/8 inch in 8 ft.
- D. Fasten casework to adjacent units and to backing.
 - 1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c.

3.3 ADJUSTING AND CLEANING

- A. Adjust hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- B. Clean casework on exposed and semi-exposed surfaces. Touch up as required to restore damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 123530

SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertops.

B. Related Requirements:

1. Section 224000 " Plumbing Fixtures" for non-integral sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Plans, sections, details, edge and backsplash profiles, and attachments to other work.
2. Locations and details of joints.
3. Locations and sizes of cutouts and holes for items installed in countertop.
4. Apply AWI's Quality Certification Program label to Shop Drawings.

C. Samples for Initial Selection: Plastic laminates in each type, color, pattern, and surface finish required in manufacturer's standard size.

D. Samples for Verification:

1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches in size.
2. Wood-Grain Plastic Laminates: For each type, color, pattern, and surface finish required, 12 by 24 inches in size.
3. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core material with specified edge material applied to one edge.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate locations and sizes of cutouts and holes for items installed in countertop and backsplashes.

- B. Product Certificates: For the following:
 - 1. Composite wood products.
 - 2. High-pressure decorative laminate.
 - 3. Chemical-resistant, high-pressure decorative laminate.
- C. Quality Standard Compliance Certificates: AWI's Quality Certification Program.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 - 1. Shop Certification: AWI's Quality Certification Program accredited participant.
- B. Installer Qualifications: AWI's Quality Certification Program accredited participant.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.
- B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.6 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

- A. Plastic-Laminate-Clad Countertop Type PLCC-1:
- B. Quality Standard: Unless otherwise indicated, comply with NAAWS for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
 - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grade specified.
 - 2. The Contract Documents contain requirements that are more stringent than that of the referenced quality standard. Comply with requirements of the Contract Documents in addition to those of referenced quality standard.
- C. Grade: Custom.
 - 1. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
- D. High-Pressure Decorative Laminate: ISO 4586-3, Grade HGF.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Formica Corporation
 - b. Nevamar Company, LLC
 - c. Wilsonart LLC
- E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As selected by Architect from manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Solid colors with core same color as surface, matte finish.
 - c. Wood grains, matte finish with grain running parallel to length of countertop.
 - d. Patterns, matte finish.
- F. Edge Treatment: Same as laminate cladding on horizontal surfaces.
- G. Core Material: As selected by fabricator to comply with quality standard.

- H. Core Material at Sinks: veneer-core plywood made with Type II adhesive.
- I. Core Thickness: 3/4 inch.
 - 1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
- B. Composite Panel Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.
 - a. Hardwood Plywood: 0.05 ppm.
 - b. Particleboard: 0.09 ppm.
 - c. MDF More Than 5/16 Inch (8 mm) Thick: 0.11 ppm.
 - d. MDF 5/16 Inch (8 mm) or Less in Thickness: 0.13 ppm.
- 2. Particleboard: ANSI A208.1, MR 50.
 - a. Grade M-2 or better; complying with performance requirements specified.
- 3. Veneer-Core Hardwood Plywood: ANSI/HPVA HP-1.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products in accordance with test method indicated by a qualified testing agency.
 - 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.4 MISCELLANEOUS MATERIALS

- A. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- B. Installation Adhesive: Manufacturer's standard product that is recommended for application indicated.

2.5 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:
 1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
- C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements before disassembling for shipment.
- D. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

- B. Examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.3 INSTALLATION OF PLASTIC-LAMINATE-CLAD COUNTERTOPS

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to extent that it was not completed in the shop.
 - 1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where indicated on Shop Drawings.
 - 1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical-treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- E. Countertop Installation:
 - 1. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 3. Anchor wall cleating necessary for proper setting for countertops not supported by casework.
 - 4. Install countertops level and true in line. Use concealed shims as required to maintain not more than 1/8-inch-in-96-inch variation from a straight, level plane.
 - 5. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
 - 6. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the referenced standard for the specified grade.
 - 1. Inspection entity is to prepare and submit report of inspection.

3.5 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where impossible to repair, replace countertops. Adjust joinery for uniform appearance.
- B. Clean countertops on exposed and semi-exposed surfaces.
- C. Protection: Provide kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123623.13

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material countertops.

B. Related Requirements:

1. Section 224000 " Plumbing Fixtures" for non-integral sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of countertop material.

B. Shop Drawings:

1. Plans, sections, details, edge and backsplash profiles, and attachment to other work.
2. Locations and details of joints.
3. Locations, quantity, and type of supports/brackets.
4. Direction of directional pattern, if any.
5. Locations and sizes of cutouts and holes for items installed in countertop.
6. Apply AWI's Quality Certification Program label to Shop Drawings.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification:

1. Countertop material, 6 inches square.
2. One full-size countertop, with front edge and backsplash, 8 by 10 inches of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate locations and sizes of cutouts and holes for items installed in countertops or backsplashes.

B. Qualification Statements: For fabricator.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include product data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

1.6 MOCKUPS

- A. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as indicated on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.
- B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.8 FIELD CONDITIONS

- A. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of countertops by field measurements before countertop fabrication is complete and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Quality Standard: Unless otherwise indicated, comply with NAAWS for grades of simulated stone countertops indicated for construction, finishes, installation, and other requirements.
 - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grade specified.
 - 2. The Contract Documents contain more stringent requirements than that of the referenced quality standard. Comply with requirements of the Contract Documents in addition to those of referenced quality standard.

2.2 SOLID SURFACE MATERIAL COUNTERTOPS

- A. Solid Surface Countertop Type SSC-1:
 - 1. Grade: Custom.
- B. Solid Surface Material: Homogeneous fabrication of mineral fillers and pigments bound together with a matrix of polymers and resins, complying with ISFA 2-01.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. DuPont; DuPont de Nemours, Inc.
 - b. Formica Corporation
 - c. Wilsonart LLC
 - 2. Colors and Patterns: As selected by Architect from manufacturer's full range.
 - 3. Countertop:
 - a. Type: Standard.
 - b. Thickness:
 - 1) 3/4-inch- thick, solid surface material with front edge built up with same material.
 - c. Exposed Edge Treatment: As selected by Architect from manufacturer's full range.
 - d. Provide drip groove 1/8 inch by 1/8 inch set back 3/8 inch from front edge of countertop.
 - e. Backsplash: Detached straight.
 - 1) Height: 4 inches.
 - 2) Thickness: 1/2 inch.

- f. End Splash: Matching backsplash.
- 4. Sink Bowls:
 - a. Top Mounted.
 - b. Material: Stainless steel.
 - c. Shape: Rectangle.

2.3 FABRICATION

- A. Fabricate countertops in sizes and shapes required to comply with requirements indicated.
- B. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- C. Joints:
 - 1. Fabricate countertops without joints.
- D. Cutouts and Holes:
 - 1. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 2. Fittings: Drill countertops in shop for grommets, plumbing fittings, undercounter soap dispensers, and similar items.
 - 3. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.4 INSTALLATION MATERIALS

- A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
 - a. Hardwood Plywood: 0.05 ppm.
 - b. Particleboard: 0.09 ppm.
 - c. MDF More Than 5/16 Inch (8 mm) Thick: 0.11 ppm.
 - d. MDF 5/16 Inch (8 mm) or Less in Thickness: 0.13 ppm.
- B. Adhesive: Product recommended by manufacturer.
- C. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.3 INSTALLATION OF SIMULATED STONE COUNTERTOPS

- A. Grade: Install countertops to comply with specified grade.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
 - 1. Provide cutouts not finished in the shop. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- C. Countertop Installation:
 - 1. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 3. Anchor wall cleating necessary for proper setting for countertops not supported by casework.
 - 4. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 5. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
 - 6. Install aprons to backing and countertops with adhesive. Mask areas of countertops and

splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

7. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls. Comply with Section 079200 "Joint Sealants."

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.
- B. Clean countertops on exposed and semi-exposed surfaces.
- C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123661

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 07 Section "Penetration Firestopping" for piping, conduit and wiring penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies and smoke barriers.
- C. Division 07 "Roof Accessories" and "Sheet Metal Flashing and Trim" for piping, conduit and equipment supports penetrating roofs, exterior walls and floors including flashings, curbs, sealants, clamps and vents.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Grout.
 - 5. Flashing Materials.
 - 6. Equipment installation requirements common to equipment sections.
 - 7. Painting and finishing.
 - 8. Concrete bases.
 - 9. Supports and anchorages.

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Actual Air: Air delivered at air-compressor outlet. Flow rate is compressed air delivered and measured in ACFM.
- C. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. D.I.S.S.: Diameter-index safety system.
- F. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- G. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

- H. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- I. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- J. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.
- K. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act NSF 372.
- L. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.
- M. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- N. LP Gas: Liquefied-petroleum fuel gas.
- O. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- P. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in SCFM.
- Q. Tepid: Moderately warm.
- R. The following are industry abbreviations:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. BR: Butyl rubber.
 - 3. Buna-N: Nitrile rubber.
 - 4. CPVC: Chlorinated polyvinyl chloride plastic.
 - 5. CWP: Cold working pressure;
 - 6. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 7. FOG: Fats, oils, and grease.
 - 8. FPM: Vinylidene fluoride-hexafluoro propylene copolymer rubber.
 - 9. FRP: Fiberglass reinforced plastic.
 - 10. HDPE: High-density polyethylene plastic.
 - 11. LPG: Liquefied-petroleum gas
 - 12. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
 - 13. NBR: Acrylonitrile-butadiene rubber.
 - 14. NRS: Non-rising stem.
 - 15. OS&Y: Outside screw and yoke.
 - 16. PE: Polyethylene plastic.
 - 17. PP: Polypropylene plastic.
 - 18. PTFE: Polytetrafluoroethylene plastic.
 - 19. PUR: Polyurethane plastic.
 - 20. PVC: Polyvinyl chloride plastic.
 - 21. PVDF: Polyvinylidene fluoride plastic.
 - 22. SWP: Steam working pressure.
 - 23. TFE: Tetrafluoroethylene plastic.
 - 24. TPE: Thermoplastic elastomer.
 - 25. uPVC: Unplasticized Polyvinyl chloride plastic.
 - 26. WAGD: Waste anesthetic gas disposal.

1.4 SCOPE

- A. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work may not be specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.
- B. It is the intent that these Specifications and associated Drawings establish minimum requirements for products and equipment with the intent to provide plumbing systems finished, tested and ready for operation. Incidental detail that is not shown or specified, but necessary for proper installation and operation shall be included in the work and in these Contractor's estimates, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each pipe and piece of equipment to minimize conflicts with other trades.
- C. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall be provided as if expressly required on both.
- D. It is the requirement of these Contract Documents to have the contractors provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation the Contractor shall include the specific components or subsystems with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

1.5 MODIFICATIONS IN LAYOUT

- A. Drawings are intended to outline the scope of work required and are not intended to be installation drawings. Drawings are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component nor do they show the exact routing and locations needed to coordinate with structure and other trades and to meet Architectural requirements. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Drawings do not necessarily show the exact routings and locations needed to fully coordinate with structure and other trades to meet Architectural requirements. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.
- B. Unless specifically stated to the contrary, no measurement of a drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the drawings are subject to measurements of adjacent and previously completed work. Measurements shall be performed prior to the actual installation of equipment.
- C. Prior to installation of visible material and equipment (including access panels) in finished spaces, review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.

- D. Check Contract Documents, as well as, Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Divisions 21 through 28 will be installed.
- E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades. Systems shall be run parallel with or perpendicular to major architectural and structural building elements.
- F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

1.6 COORDINATION

- A. Coordinate arrangement, mounting, and support of piping and equipment:
 - 1. To maintain maximum headroom; all piping, duct, conduit and associated components to be as tight as possible to underside of structure to provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 2. To allow right of way for piping installed at required slope.
 - 3. To be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified by the architect. Locations of access doors are to be shown on coordination drawings and approved by the Architect prior to installation.

1.7 COORDINATION DRAWINGS

- A. When included as part of the Contract Documents, there shall be full cooperation and coordination of all specialty trades.

1.8 RECORD DOCUMENTS

- A. Record Drawings are specified in Division 01 Section "Project Record Documents."
- B. The Contractor shall keep a detailed up-to-date record, of the manner and location in which installations are actually made, indexing pipe, valve, and piece of equipment. Record documents are to reflect all changes in work including change orders, field directives, addenda from bid set of Contract Documents, request for information responses, etc. Upon completion of the project, the contractor shall modify the project electronic drawing and specification files to incorporate this information. Modified documents shall be turned over to the Owner in both electronic and hard paper copy formats. Record drawings shall also include:
 - 1. Locations of buried piping or similar items. Include buried depth.
 - 2. Field changes of dimension or detail.
 - 3. Changes made by field order or change order.
 - 4. Details not on original contract drawings.

1.9 MAINTENANCE MANUALS AND OPERATING INSTRUCTIONS

- A. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in a coordinated manual. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment.
- B. The manuals shall include the following and shall have an index of contents and tabs for each Specification Section and each piece of equipment specified in that Section and be provided in the order listed below, per Specification Section.
 - 1. Copies of all approved submittals/shop drawings.
 - 2. Manufacturer's operating and maintenance instructions and parts lists of all items or equipment. Where manufacturer's data includes several types or models, the applicable type or model shall be clearly designated.
 - 3. Startup and shutdown procedures.
 - 4. Flow diagrams.
 - 5. Test records.
 - 6. Wiring diagrams.
 - 7. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment.
 - 8. Owner's written acknowledgement of satisfactory completion of instruction period.
- C. Furnish three copies of manuals to Architect for approval and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.
- D. Operating instructions: Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct Owner's operating personnel in any or all parts of all systems. Factory-trained personnel shall perform instructions.

1.10 SUBMITTAL PROCEDURE AND FORMAT

- A. This Article supplements Division 1.
- B. Submittal Cover Sheet
 - 1. Submittal data for each product shall include a copy of the following cover sheet completely filled out. Incomplete or incorrect cover sheet submittal shall constitute reason for rejection.
 - 2. Material submittals shall be organized by specification section. All items requiring a submittal per each specification section shall be combined into a single submittal. Provide each section/item within that submittal with its own cover sheet labeled and tagged to match the drawings.
- C. Contractor shall submit a schedule specifically indicating which piping material will be utilized in each application.

- D. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be 1/4 inches = 1 foot 0 inch scale unless specified otherwise.
- E. Shop drawings and submittals showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
- F. Provide shop drawing submittals showing details of piping connections to ALL equipment. If connection details are not submitted and connections are found to be installed incorrectly in the field, this contractor shall reinstall them within the original contract price.
- G. Shop drawings for different systems and equipment shall be bound separately by specification section as indicated above and not bound by manufacturer. Each separate submittal shall have its own transmittal and cover letter. Submittals which contain different specification section systems bound together may be returned un-reviewed for re-submittal.

1.11 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. All piping materials shall bear label, stamp, or other markings of specified testing agency, including but not limited to Underwriters Laboratory (UL) and the Cast Iron Soil Pipe Institute (CISPI).
- D. Electrical Characteristics for Plumbing Equipment: Equipment of different electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at the contractor's expense. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- E. All electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Skid-mounted or packaged assemblies shall be listed and labeled as an assembly, not just the individual components.
- F. Fire-Resistance Ratings: Where indicated, provide penetration firestopping devices tested for fire resistance per ASTM E 814 by a testing agency acceptable to authorities having jurisdiction. Indicate design designations from UL's "Fire Resistance Directory."
- G. Installer Qualifications:

1. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
 2. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.
 3. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
 4. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 5. A factory-trained representative shall provide on-site training for the contractor's field personnel in the proper installation of all mechanical type joint products within any piping system. The representative shall periodically visit the job site to ensure best practices in grooved joint installations are being followed. A distributor's representative is not considered qualified to conduct the training
- H. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.
1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.
 2. Inspection Requirements:
 - a. A manufacturer's factory trained representative shall periodically visit the job site and review the installation for best practices. This shall be at the expense of the installing contractor. The installing contractor shall correct any identified deficiencies.
 - b. Grooved end products that have been examined and have not met the visual inspection criteria for proper installation must be corrected and re-examined by the manufacturer's Inspection Services prior to the completion of the project. Any product that has not been corrected or was not examined will not be considered as part of the successful completion of Inspection Services.
- I. NSF Standard: Comply with NSF 61, "Drinking Water System Components – Health Effects," for all components, including piping, equipment, and fixture material that will be in contact with potable water. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
1. All plumbing components, including but not limited to piping, valves, backflow preventers, fixtures, etc that are connected to the domestic water system which convey water to be used for human consumption shall meet the NSF-372, 'Lead-Free' requirements. Items not intended to dispense water for human consumption such as flush valves, tub fills, shower valves, or piping accessories connected to non-potable water systems, are not required to meet the 'Lead Free' requirements.
- J. Acceptable Manufacturers

1. The Engineer's design for each product is based on the manufacturer listed in the schedule or shown on the drawings. In Part 2 of some technical specifications, other manufacturers are listed as being acceptable. The listing of a manufacturer as acceptable does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. These are acceptable only if, as a minimum, they:
 - a. Meet all performance criteria listed in the schedules and outlined in the specification.
 - b. Have identical operating characteristics to those called for in the specification. For example, a two-stroke diesel generator will not be acceptable if a four-stroke model is specified.
 - c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Engineer has determined that the manufacturer's products will fit within the available space - this determination is solely the responsibility of the contractor.
 - d. Products must adhere to all architectural considerations including but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers, lighting and plumbing fixtures - being the same size and of the same physical appearance as scheduled or specified products.
 - e. All equipment shall be labeled or listed by the National Board of Underwriters Laboratories (U.L.) where such labeling or listing exists for such material.
 - K. All components within a single plumbing system shall be compatible with one another per the manufacturer(s).
 - L. All individual components in each plumbing system shall be from a single manufacturer.
- 1.12 TEMPORARY SERVICES/CONTINUITY OF UTILITY SERVICES
- A. In the absence of specific requirements in Division 1, comply with the following procedures for shut-downs.
 - B. Provide temporary services where project construction schedule requires extended shut downs of existing equipment and/or systems. Temporary services include the necessary equipment and/or systems to maintain continuity of services. Extended shut downs are interruptions of existing services for a period of time longer than that acceptable to the Owner.
 - C. Contractor shall coordinate any shutdowns of existing systems as follows:
 1. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days is required.
 2. Minimize timeline of shutdowns of any system.
 3. Provide temporary services where required and perform shutdowns and tie-ins at a time convenient to Owner.

4. Contractor shall be responsible for completing and filing the Owner's shutdown notice questionnaire.
5. Perform required survey and inspection work required by the notice for shutdown.
6. All life safety systems shall be returned to service at the end of each work day, when work is being performed on the systems. It is the responsibility of the Contractor to provide all associated appurtenances necessary to ensure that the systems are in proper working condition at all times.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Store ALL plastic piping and valves protected from direct sunlight. Support to prevent sagging and bending.
- B. Protect equipment/materials from damage during shipping, storage, handling and installation. Delivery equipment/materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- C. The Contractor shall provide for enclosed storage, when equipment/materials are stored on-site and prior to building "dry-in", to prevent any damage resulting from inclement weather or construction traffic. Specialties shall not be stored outdoors.
- D. Equipment/materials, stored or installed, found to be damaged shall be replaced with new by the Contractor, to the satisfaction of the Owner and at no additional expense. Do not store equipment with PVC material with exposure to direct sunlight.
- E. Deliver fuel gas and medical gas pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection. This is applicable for all Division 22 sections.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

- F. Plain End Pressure Piping to join plastic and stainless steel piping: Utilize double lip seal with bolt tightening pattern. Product shall be equal to Norma FGR Series.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Pipe sizes 2 and smaller, factory-fabricated, union assembly, for 300-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Pipe sizes 2-1/2" and larger, factory-fabricated, companion-flange assembly, for 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.7 FLASHING MATERIALS

- A. All piping, conduits and equipment supports through roofs shall be flashed. Flashing materials and methods shall be in accordance to the roof manufacturer's and Division 07 requirements.

2.8 CEILING ACCESS AND ACCESS PANELS

- A. Access panels are generally not shown on the drawings, but they are required to be provided by Contractor.
- B. Furnish access panels for installation under other Sections valves or other items installed under this Division require access and are concealed in floor, wall, furred space or above ceiling. Access panels shall be by Milcor, Knapp, Nystorm or Inland Steel; coordinate selection

with other Sections supplying similar access panels. Color of panel shall be selected by the Architect.

- C. Access panels shall have same fire rating classification as surface penetrated. Rated access panels must have U.L. Label.
- D. Final locations of access panels shall be approved by the architect and/or owner prior to installation.
- E. All equipment or valves shall be located within two feet above the access panel.

2.9 SLEEVES

A. Below Ground applications:

- 1. For piping passing from dirt outside of the building footprint through a foundation/basement wall and into the building, a sleeve with an integral water stop shall be utilized. The sleeve can be either HDPE or galvanized steel as manufactured by GPT or approved equal. The sleeve shall be cast into the pour of the structure.
- 2. When piping is passing from dirt outside of the building footprint to dirt under the building through a structural element, the water-stop on the sleeve is not required. In this application, the sleeve can be either cast iron or PVC piping.
- 3. Between the carrier piping and the sleeve, a mechanical seal, equal to that manufactured by GPT Link Seal, shall be utilized. Select the number of interlocking rubber links required to make installation watertight.

B. Above ground piping passing through concrete floors:

- 1. Cast in place sleeves: Piping passing through a floor shall be provided with a sleeve with an integral fire and water-stopping in one device equal to Holdrite Hydroflame. The sleeve shall be cast into the pour of the structure.
 - a. At the contractor's option, the sleeve can be either HDPE or galvanized steel with integral water stop as manufactured by GPT or approved equal. The sleeve shall be cast into the pour of the structure. This method requires separate firestopping by the contractor.
- 2. Sleeves for core-drilled locations: The annular space between the piping and the core shall be provided with mechanical seals equal to that manufactured by GPT Link Seal. Select the number of interlocking rubber links required to make installation watertight.
- 3. Note: Sleeves are only required for elevated floors. Slab on grade do not require sleeves when a water proofing membrane is not utilized.

C. Above ground piping passing through concrete walls:

- 1. All piping passing through a concrete wall shall be sleeved with either steel or cast iron piping.

PART 3 - EXECUTION

3.1 PRE-BID SITE VISIT

- A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this division. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.
- B. Contractor shall visit job site to familiarize himself with the specific location of the new equipment installations in existing areas, to ensure there is adequate access for the installation of equipment. All entries, pathways, corridors, stairwells, etc., that may be used to install equipment shall be investigated. All existing conditions and potential obstructions that may impede access and installation shall be addressed prior to equipment purchasing/ordering.
- C. The documentation of existing conditions was derived from As-Built documents and are in part unverified. Actual existing conditions shall be verified prior to commencement of work.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Install all piping, systems, equipment, etc. per local code and per the local authority having jurisdiction's (AHJ) requirements. Should any part or component of the drawings or specifications conflict with the local code requirements, the local code requirements shall prevail. The contractor shall inform the design team immediately of any code conflicts.
- C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- D. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Exposed surface mounted piping subject to potential damage shall be metallic.
- F. To maintain maximum headroom, all piping, duct, conduit, and associated components shall be installed as tight as possible to underside of deck/structure to provide for ease of disconnecting the equipment with minimum interference to other installations.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- H. Install piping to permit valve servicing. No valving shall be located more than 24" above the access panel or removable ceiling panels. Provide necessary fittings and pipe drops, bends, etc to ensure all valving is accessible.
- I. Install piping at indicated slopes.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install piping to allow application of insulation.
- M. Select system components with pressure rating equal to or greater than system operating pressure.

- N. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe, conduit and wiring penetrations. Seal penetrations with fire- and smoke-stop materials. Refer to Division 07 for firestopping and fill materials.
- O. Waterproof Penetrations: Maintain integrity of waterproof roof, wall and floor penetrations for pipe, conduit and equipment support penetrations. Seal penetrations with waterproof materials with clamps, sleeves, flashings, pipe boots and/or pipe curb assemblies as detailed or specified. Refer to Division 07 for waterproofing methods and materials when not specified in this section.
- P. Verify final equipment locations for roughing-in.
- Q. Perform work and provide material and equipment as shown on Drawings and/or as specified and/or indicated in this Section of the Specifications. Completely coordinate work with work of other trades and provide a complete and fully functional installation.
- R. All exposed piping, fittings, valving, and devices in all food service locations shall be provided with a chrome finish. As an alternate all copper pipe and tube is allowed to be provided with chrome paint in lieu of chrome plating. Exposed copper indirect drain piping does not require painting or plating.
- S. All exposed traps, tailpieces, supply and waste piping/tubing and fittings, stops, and the like serving all plumbing fixtures food service locations shall be provided with a chrome finish. As an alternate all copper pipe and tube is allowed to be provided with chrome paint in lieu of chrome plating.
- T. Provide plugs or caps for all opening during the construction phase. The temporary plug shall be plastic cap or equivalent. Duct tape is unacceptable for use as a plug, support or to separate ferrous from non-ferrous materials for the construction phase.
- U. All materials (e.g. firestopping, insulation mastic, cutting oils, etc.) that are used not only as part of the plumbing system with the CPVC piping, but all products from any other trade that may come in contact with the CPVC piping, shall be listed as approved on the Lubrizol CPVC compatibility charts and by the piping manufacturer. Contractor shall ensure no low voltage cabling is in contact with any CPVC piping.
- V. All metal framing members with either factory stamp openings or field punch shall have a plastic sleeve or grommet in place prior to installing any plastic tubing.
- W. In concealed locations where piping, other than cast-iron or galvanized steel, is installed through holes or notches in studs, joists, rafters, or similar members less than 1.5" (38mm) from the nearest edge, the piping shall be protected by strike plates (caddy nail plates model #304B2). This is to help protect piping from drywall screws. Piping is to run in the center of stud cavity wherever possible.
- X. Install sleeves for piping passing structural elements as indicated above.
- Y. Per NFPA 90A, no combustible piping serving water, waste, vent or storm shall be located within any HVAC shaft. Additionally, no gas piping of any type shall share a shaft with ductwork.
- Z. Provide a field constructed/fabricated emergency drain pan under all piping located above an electrical room, tele/data room, IT room, transformer room, or any similar room having electrical or low-voltage equipment, gear, panels, and controls to minimize the chance of dripping onto the device. Emergency drain pan shall be designed to have a pipe connection routed to discharge 3" above the floor adjacent to the door entering into the space.

- AA. All metallic piping/components in direct contact with either dirt or concrete shall be provided with a 35 mil thick flexible wrap or sleeve equal to Tapecoat CT. Primer to be Tapecoat CT Coldprime or approved equal.
 - 1. The exceptions include all stainless steel piping as well as cast iron when installed in non-corrosive soils.
- BB. Coordinate with the electrical contractor to ensure all metallic piping is grounded per the NEC requirements.
- CC. Horizontal piping is not to be installed/embedded within a concrete slab unless specifically noted as such.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install all equipment per the manufacturer's recommendations.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
- D. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment to allow right of way for piping installed at required slope.
- F. Any equipment that may require passwords for access of the controls, shall be provided at no cost to the owner for the life of the system.

3.5 PAINTING

- A. Painting of Plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

- C. All plastic piping exposed to direct sunlight shall be painted with 2 coats of water based latex paint.

3.6 CONCRETE BASES

- A. Provide raised concrete pads for all floor mounted equipment.
- B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions at Project. Where specific requirements are not specified in Division 3 or detailed on the Drawings, comply with the following at a minimum:
 - 1. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated.
 - 2. Edges of concrete bases shall have a minimum 1-1/2 inch chamfer.
 - 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 6. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 7. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 8. Use 3000-psi, 28-day compressive-strength concrete with wire-mesh reinforcement.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.
- D. Fireproofing:
 - 1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, prior to start of spray fiber work.
 - 2. Piping and other items which would interfere with proper application of fireproofing shall be installed after completion of spray fiber work.
 - 3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by trade responsible for damage and shall not constitute grounds for extra cost to Owner.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.10 WELDING

- A. Weld only by approved acetylene or electric welding processes and welders shall hold certificate from approved insurance company.
- B. Conduct test to demonstrate suitability of procedures to be used in making welds, which conform to specified requirements.
- C. Specification for welding procedure shall meet requirements of Welding Qualifications, Section IX, ASME Boiler and Pressure Vessel Code and ANSI B31.1.
- D. Align components. No strain shall be placed on weld during welding. No part of pipe shall be offset more than 20% of thickness. Set flanges and branches properly.
- E. Welder and Brazing Qualification:
 - 1. Test welders to demonstrate ability to make acceptable welds. Tests conducted for qualification of welder for work under one Division or Section shall not necessarily qualify welder for work under another Division or Section.
 - 2. Tests shall be as prescribed for welder qualification in Section IX of the ASME code.
 - 3. Records of such tests shall be as follows: Each welder shall be assigned an identifying number, letter or symbol. Identifying mark shall be stamped adjacent to welds made by this welder. Identification shall be at top of horizontal piping and at front of vertical piping.
 - 4. Maintain record of welders employed, showing dates and results of tests and identifying mark assigned to each welder. Certify records and make them accessible to Owner's project representative and/or project manager. Before completion of project, one copy of records shall be turned over to Owner.

5. No qualification shall be older than three years when welder commences work on this project. If welder has not welded in required welding process for a period of six months, he shall be re-certified.

F. Welding Tests

1. As designated by Architect, remove welds for destructive testing or for testing by non-destructive means. Tests shall be as determined by Architect.
2. If, in Architect's opinion, welds so tested do not meet requirements of Sections VIII and IX of ASME, then the Contractor shall pay for the costs of the tests. Remove welds welded by that welder, at no cost to the Owner. Rewelding shall be performed by qualified welder other than welder whose welds did not pass test. Welders whose welds were defective shall not be employed on site for remainder of project.
3. Welding of stanchions, brackets, anchors and other welding not performed on pipe joints shall be in accordance with requirements of AWS specifications and requirements.

3.11 MISCELLANEOUS TESTING AND BALANCING

- A. Tests for piping systems and equipment shall be performed as specified in their respective specification sections.
- B. No part of any underground work shall be covered until after it is inspected, tested, approved, and photographed.
- C. Provide all equipment required for testing, including fittings for additional openings as required.
- D. Notify the Architect and any Inspectors required to observe the test, at least 48 hours prior to when the test is ready to be performed.
- E. The General Contractor is responsible for certifying in writing, the results of all testing of systems and equipment in this contract. These written results will be required at project close-out.
- F. Include description and what portion of the system has been tested. Record date, time, test medium and pressure used, name and title of the person certifying the test. This person shall sign the certification. Forms and data must be legible.
- G. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or materials as necessary, and repeat the inspection and test. Make repairs with new materials. No caulking of holes or screwed joints will be allowed.
- H. Maintain complete records at the job site of all testing that has been certified. At completion of the project, include in the instruction manuals clearly legible copies of all test approval records and certification.
- I. Balance the entire new water distribution system. Set all balancing valves for proper flow control of all circulating water.
- J. All flushing valves, pressure regulating valves, or other regulating devices shall be adjusted for proper balancing and flow to the plumbing fixture and/or equipment.

3.12 EXPANSION PROVISIONS

- A. Installation of piping must allow for expansion using offsets, loops, swing joints, expansion joints, etc., as necessary to prevent undue strain. Take-offs from mains to run-outs shall not have less than a three-elbow swings.
- B. Mains and risers with loops or offsets shall be securely anchored to structure so as to impart expansion toward loops or offsets. Anchors shall be constructed of heavy forged wrought iron, secured to pipe and to structure. Provide vibration isolation as required.
- C. Provide pipe alignment guides as required to guide expanding pipe to move freely from anchor points toward expansion joints, offsets, etc.
- D. All wood framed structures shall be provided with expansion joints equal to Fernco Expansion Joints on every third floor starting at the top, on every sanitary, storm, and vent stack. The coupling shall allow for a minimum of 1.5" of pipe expansion/wood shrinkage.

3.13 INSTALLATION ONLY ITEMS

- A. Where this contractor is required to install items which he does not purchase, he shall coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. This contractor shall be responsible for:
 - 1. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
 - 2. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
- B. This Contractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of this Contractor will be considered only if presented in writing within one week of their date of delivery. Unless such claims have been submitted, this Contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

3.14 CLEANING

- A. Cleaning shall be performed prior to system start-up.
- B. Piping
 - 1. General:
 - a. After all piping systems have been pressure tested and approved for tightness, flush and clean piping as specified and as required by codes.
 - b. Furnish pipe cleaning chemicals, chemical feed equipment, materials and labor necessary to flush and clean piping.
 - c. Permanently install necessary chemical injection fittings complete with stop valves.

- d. Monitor the water temperatures and prevent the heat generated by the pump circulating the water from causing the water temperature to exceed the temperature ratings of the pipe, pumps, and other components of the piping system during the flushing and cleaning process.
 - e. Contractor to provide a portable temporary pumping apparatus for the purpose of flushing and cleaning. Pump shall be adequate to provide the required velocities necessary for the process.
 - f. When external surfaces of piping are rusted, clean and restore surfaces to original condition.
2. Flushing:
- a. All water side equipment control valves, strainers, etc., shall be bypassed prior to and during the flushing process.
 - b. Flush all water, steam and condensate systems clear of all dirt and foreign matter with all pumps bypassed. All flushing to be at a circulation rate of 6 f.p.s.
 - c. Maintain continuous blowdown and make-up, as required during flushing operation.
 - d. Once flushing is complete and prior to cleaning, all final connections to equipment shall be performed.
 - e. Water samples taken from the system during flushing shall determine when the system is ready for the cleaning process.
3. Cleaning:
- a. Clean all pipeline strainer baskets and return to original condition or replace with new baskets prior to the pipe cleaning process.
 - b. The cleaning chemicals shall be designed to remove deposition from construction, such as pipe dope, oils, loose mill scale, and other extraneous silt and mud. The products shall inhibit corrosion of the various metals in the system and shall be safe to handle and use with normal chemical safety equipment, i.e., gloves and safety glasses. Effectiveness of the product shall be such that the water need only be at ambient temperatures.
 - c. During the cleaning procedure, remove strainers, automatic air vents, flow regulators and any other item that would be affected by the clean and flush procedure. All control valves and coils should be set up for wide open, full flow.
 - d. After initial flushing of a system, use portable pumping apparatus for a continuous 24 hour circulation of a cold water detergent equal to Nalco 2567 cleaner.
 - e. After circulating for the prescribed time, systems shall then be drained and flushed until the total alkalinity or conductivity of the rinse water is not more than 20% higher than the readings for the make-up water. Refill with clean water and treat with scale and corrosion inhibitor. Contractor shall furnish the chemicals, supervise the cleaning, test the water after flushing, and shall provide a report that certifies successful cleaning and flushing of the piping.
4. Equipment

- a. After completion of project, clean the exterior surface of all equipment, including concrete residue, dirt, paint residue, etc.
- b. Clean all equipment and plumbing fixtures, as recommended by manufacturer.
- c. Thoroughly disinfect all water heating equipment and the complete new domestic water piping system according to Department of Health requirements.
- d. All dirt, plaster dust and other foreign matter shall be blown and/or cleaned from coils, terminal devices, diffusers, registers, and grilles.
- e. Thoroughly clean equipment of all stains, paint spots, dirt, and dust. Remove all temporary labels not used for instruction or operation.

END OF SECTION 220500

SECTION 220510 – PLUMBING DEMOLITION AND ALTERATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Disconnection of plumbing equipment in selected portions of building or structure.
 - 2. Demolition and removal of selected plumbing components.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Division 01 Section "Cutting and Patching."
 - 2. Division 02 Section "Selective Structure Demolition" for sequencing and scheduling procedures and requirements for demolition activities.

1.3 JOB CONDITIONS

- A. Perform all demolition as needed to accomplish new work.
- B. Do not rely solely on plumbing drawings to determine extent of general construction demolition. Refer to architectural demolition plans for the exact extent of general construction demolition required by this contract.
- C. This Contractor is responsible for all charges, fees etc. incurred as a result of the plumbing portion of the demolition.
- D. Prior to demolition or alteration of structures, the following shall be accomplished:
 - 1. Review available record documents of the existing construction. Owner does not guarantee that existing conditions are same as those indicated in record documents.
 - 2. Coordinate sequencing with Owner and other Contractors.
 - 3. Coordinate means to separate construction zones from non-renovated zones to prevent the spread of dust, fumes and debris.
 - 4. Except as noted otherwise, remove from the premises, all materials and equipment removed in the demolition work.
 - 5. Equipment noted to be removed and turned over to the Owner, shall be delivered to the Owner at a place and time he so designates.
 - 6. Where the materials are to be turned over to the Owner or reused and installed by the Contractor, it shall be the Contractor's responsibility to maintain the condition of the

materials and equipment equal to that existing before work began. Damaged materials or equipment shall be repaired or replaced at no additional cost to the Owner.

7. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore existing facilities to their pre-demolition condition, at no additional cost to Owner.
8. Salvage equipment scheduled for reuse in new work or scheduled to be delivered to Owner's storage facility.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Existing plumbing equipment in conflict with new construction shall be removed and/or relocated as indicated on the drawings, as directed or needed. This Contractor shall remove all plumbing equipment released from service as a result of construction, and no equipment removed shall be reused, except as specifically directed on the drawings or elsewhere herein. All plumbing components shall be stored on site for Owner assessment. Any components not retained by the Owner shall be removed by the contractor. Properly dispose or remove from site any items not retained by Owner.
- B. Any existing services or equipment not shown on the drawings and which are logically expected to be continued in service and which may be interrupted or disturbed during construction, shall be reconnected in an approved manner. Provide temporary pipes, controls, etc., as needed to prevent interruption of service to occupied areas caused by demolition operations. In addition, any piping, fixtures, or equipment which may require relocation or rerouting as a result of construction, shall be considered a part of the work of this section and shall be done by this Contractor with no additional compensation, provided that the referenced relocation is discernable from the pre-bid review of the site, and associated documents.
- C. This Contractor shall remove all fixtures, piping, hangers, and existing equipment, being discontinued or removed due to construction. Abandoned or removed services shall be disconnected and capped at the perimeter of the project or as required elsewhere in the documents. Piping shall be capped with the same or compatible piping material. Piping being abandoned in place shall be drained.
- D. The existing building is to remain in operation during construction. This Contractor shall coordinate all work that will interfere with the present operation of the facility with the Owner and Construction Manager.
- E. All existing equipment that is to remain shall be cleaned inside and out. Clean all pipeline strainer baskets and return to original condition or replace with new baskets. All dirt, plaster dust and other foreign matter shall be blown and/or cleaned from all equipment. Touch up paint on equipment in exposed areas.
- F. Equipment being removed shall be disconnected and have the services capped.

- G. Equipment being removed and reinstalled shall be disconnected, have the services capped, remove, clean and store the equipment until appropriate the reinstalled, connected and made operational.
- H. Equipment being removed and salvaged shall be disconnected and have the services capped. The equipment shall then be turned over to the owner.
- I. Plumbing fixtures indicated to remain shall be wiped clean on all surfaces to remove all dirt, plaster dust or other foreign materials.
- J. All coring that is required for plumbing work shall be done by this Contractor.
- K. All cutting and patching required for plumbing work shall be by this Contractor.
- L. This Contractor shall provide required additional support for existing piping in remodeled area that is not being removed and is not properly supported.
- M. When existing piping or related equipment in remodeled areas prevents the installation of other work, remove and reinstall existing materials, making necessary modifications and transitions to coordinate with other trades.
- N. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 CLEANING AND REPAIR

- A. Clean existing materials and equipment which remain or are to be reused. Report damage or defects to Architect

END OF SECTION 220510

SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bimetallic-actuated thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gauges.
 - 4. Gauge attachments.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Available Manufacturers:
 - 1. Terice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - 3. Winters Instruments
- B. Thermometers shall be 5 inch, round bi-metal type, stainless steel case, readable scale and gradations from 30 degrees F. to 240 degrees F., external calibrator adjustment, back or bottom connection as appropriate. Provide brass extension neck sockets of appropriate length. Thermometers shall be equal to Terice Series #B85200.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Bore Diameter and Insertion length: Required to match thermometer bulb or stem.
4. Lagging Extension: Include on thermowells for insulated piping and tubing.
5. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.3 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

1. Available Manufacturers:
 - a. Terice, H. O. Co.
 - b. Weiss Instruments, Inc.
 - c. Winters Instruments
2. Pressure gauge shall be 4-1/2 inch die cast aluminum case, double strength glass window, readable dial scale with gradations from 0 psi to 200 psi phosphor bronze bourdon tube, stainless steel movement. Provide shutoff valve with pressure gauge. Shall be equal to Terice Series #500X.
3. Pressure gauge shall be 3-1/2 inch die cast aluminum case, double strength glass window, readable dial scale with gradations from 0 psi to 200 psi, phosphor bronze bourdon tube, brass socket. Provide shutoff valve with pressure gauge. Shall be equal to Terice Series #600.
4. Pressure gauge shall be 3-1/2 inch stainless steel case, glass window, readable dial scale with gradations from 0 psi to 200 psi, phosphor bronze bourdon tube, brass socket. Provide shutoff valve with pressure gauge. Shall be equal to Terice Series #690.

2.4 GAUGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 PETES PLUGS

- A. Brass or stainless valve body with a pressure rating higher than the system pressure consisting of self-closing valves with a restrained gasketed cap on the top. Utilize valve material compatible with hot and cold domestic water.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in pipe tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install pressure gauges in piping tees with gauge located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gauge for fluids.
- H. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each domestic water chiller.
- I. Install pressure gauges in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.
- J. Install petes plugs in the following locations:
 - 1. Suction and discharge of each domestic water pump.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Inlet and outlet of each water heater.
 - 4. Inlet and outlet of each domestic hot-water storage tank.
- K. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.
- L. Adjust faces of meters and gauges to proper angle for best visibility.
- M. Thermometers and pressure gauges shall be any of the respective items listed in the above sections.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ball valves.
 - 2. Butterfly valves.
 - 3. Check valves.
 - 4. Gate valves.
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.4 PERFORMANCE REQUIREMENTS

- A. Products shall be suitable for the indicated service including piping system fluids, materials, pressures, and temperatures.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
 - 1. All plumbing components, including but not limited to piping, valves, backflow preventers, fixtures, etc that are connected to the domestic water system which convey water to be used for human consumption shall meet the NSF-372, 'Lead-Free' requirements. Items not intended to dispense water for human consumption such as flush valves, tub fills, shower valves, or piping accessories connected to non-potable water systems, are not required to meet the 'Lead Free' requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- B. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve Bypass and Drain Connections: MSS SP-45.

- G. Valves with push type connections are prohibited. Valves with press connections are only allowed in systems where press connect fittings are allowed. Valves with PEX connections are only allowed in systems fully utilizing PEX piping. In grooved installations, grooved-ended valves shall be the same manufacturer as the grooved system.

2.2 BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim or Heat Treated Forged Brass Ball valve with Heat Treated Forged Brass Trim:

- 1. Manufacturers:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Jomar Valve
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.

- 2. Description:

- a. Standard: MSS SP-110 or MSS SP-145.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze or Heat Treated Forged Brass.
- f. Seats: PTFE or TFE.
- g. Stem: Bronze or Heat Treated Forged Brass.
- h. Ball: Chrome-plated brass.
- i. Port: Full.
- j. If a heat treated brass alloy valve is utilized, it must be CW511L tested in accordance with ISO 6509.

- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim or Heat Treated Forged Brass Ball valve with Heat Treated Forged Brass Trim:

- 1. Equal to Nibco 585-66-LF with optional stainless steel lever handle.
- 2. Manufacturers:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Jomar Valve
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.

- 3. Description:

- a. Standard: MSS SP-110 or MSS SP-145.
- b. SWP Rating: 150 psig.

- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze or Heat Treated Forged Brass.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Handle: stainless steel.
- j. Handle nut: stainless steel.
- k. Port: Full.
- l. If a heat treated brass alloy valve is utilized, it must be CW511L tested in accordance with ISO 6509.

2.3 BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze or Stainless Steel Disc:

1. Manufacturers:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Hammond Valve.
- c. Jomar Valve
- d. Milwaukee Valve Company.
- e. NIBCO INC.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze or stainless steel.

B. 300 PSI Grooved, Stainless Steel Butterfly Valves

- 1. Manufacturer: Victaulic 861
- 2. Description: 2" and larger, 300 psi maximum pressure rating, suitable for bi-directional and dead-end service to full rated pressure. Grooved end stainless steel body and disc, grade CF8M, conforming to ASTM A351, with blow-out proof 17-4PH stainless steel stems to ASTM A564. Disc shall be connected to the stem without the use of fasteners or pins, and be offset from the disc centerline to provide a full 360° continuous contact with the seating surface when closed. Seat shall be pressure responsive, Grade P Fluoroelastomer.

C. 300 PSI, Grooved, Brass Butterfly Valves with Aluminum Bronze Disc

1. Manufacturers: Victaulic #608N
2. Description: 2-1/2" - 4", 300 psi maximum pressure rating, with copper tubing sized grooved ends. Cast brass body to UNS C87850. (Alloy code shall be cast or stamped into the valve body.) Aluminum bronze disc to UNS C95500, with pressure responsive fluoroelastomer blend seat optimized for improved resistance to chlorine, chloramine, and other typical potable water disinfectants. UL Classified in accordance with ANSI/NSF 61 for cold and hot potable water service and ANSI/NSF 372. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating. Bubble tight, dead-end or bi-directional service, with memory stop for throttling, metering or balancing service. Valve may be automated with electric, pneumatic, or hydraulic operators. Certified to the low lead requirements of NSF-372.

2.4 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves:

1. Manufacturers:
 - a. Conbraco Industries, Inc.; Apollo Valves
 - b. Crane Co.; Crane Valve Group;
 - c. Hammond Valve.
 - d. Jomar Valve
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-80 Type 3 or Type 4, or MSS SP-139.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B584, bronze.
 - e. Disc Seat: Bronze or PTFE.

2.5 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers:
 - a. Crane Co.; Crane Valve Group
 - b. Jomar Valve
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Powell Valves.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:

- a. Standard: MSS SP-71, Type I.
- b. CWP Rating: 200 psig.
- c. Body Design: Clear or full waterway.
- d. Body Material: ASTM A 126, gray iron with bolted bonnet.
- e. Trim: Bronze.
- f. Gasket: Asbestos free.

2.6 BRONZE GATE VALVES

A. Class 125 Bronze Gate Valves:

1. Manufacturers:

- a. Crane Co.; Crane Valve Group;
- b. Hammond Valve.
- c. Milwaukee Valve Company.
- d. NIBCO INC.
- e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80 or MSS SP-139.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B584, bronze with integral seat and screw-in bonnet.
- d. Stem: Bronze.
- e. Disc: Solid wedge; bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron or aluminum.

B. Class 150 Bronze Gate Valves:

1. Manufacturers:

- a. Hammond Valve.
- b. Milwaukee Valve Company.
- c. NIBCO INC.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80 or MSS SP-139.
- b. CWP Rating: 300 psig.
- c. Body Material: ASTM B584, bronze with integral seat and union-ring bonnet.
- d. Stem: Bronze.
- e. Disc: Solid wedge; bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, or aluminum.

2.7 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers:

- a. Hammond Valve.
- b. Jomar Valve
- c. Kitz Corporation.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Trim: Bronze.
- e. Disc: Solid wedge.
- f. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Examine grooved ends for form and cleanliness. Ends shall be clean and free from indentations and projections in the area from valve end to (and including) the groove.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions, grooved-joint couplings, or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary. Where piping is more than 24" above an accessible ceiling, provide a drop in the pipe to bring the valve to within 24" of the ceiling.

- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) or grooved-end type.
 - 3. Throttling Service: Ball or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. Valve pressure ratings shall be no less than the system pressure for any application. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Ball Valves: Two piece, full port, with brass or stainless-steel trim.
 - 2. Bronze Swing Check Valves: bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
 - 2. Brass Butterfly Valves: 300 PSI, aluminum-bronze disc, grooved ends.

3. Stainless Steel Butterfly Valves: 300 PSI, stainless-steel disc, grooved ends.
4. Iron Swing Check Valves with nonmetallic-to-metal seats.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

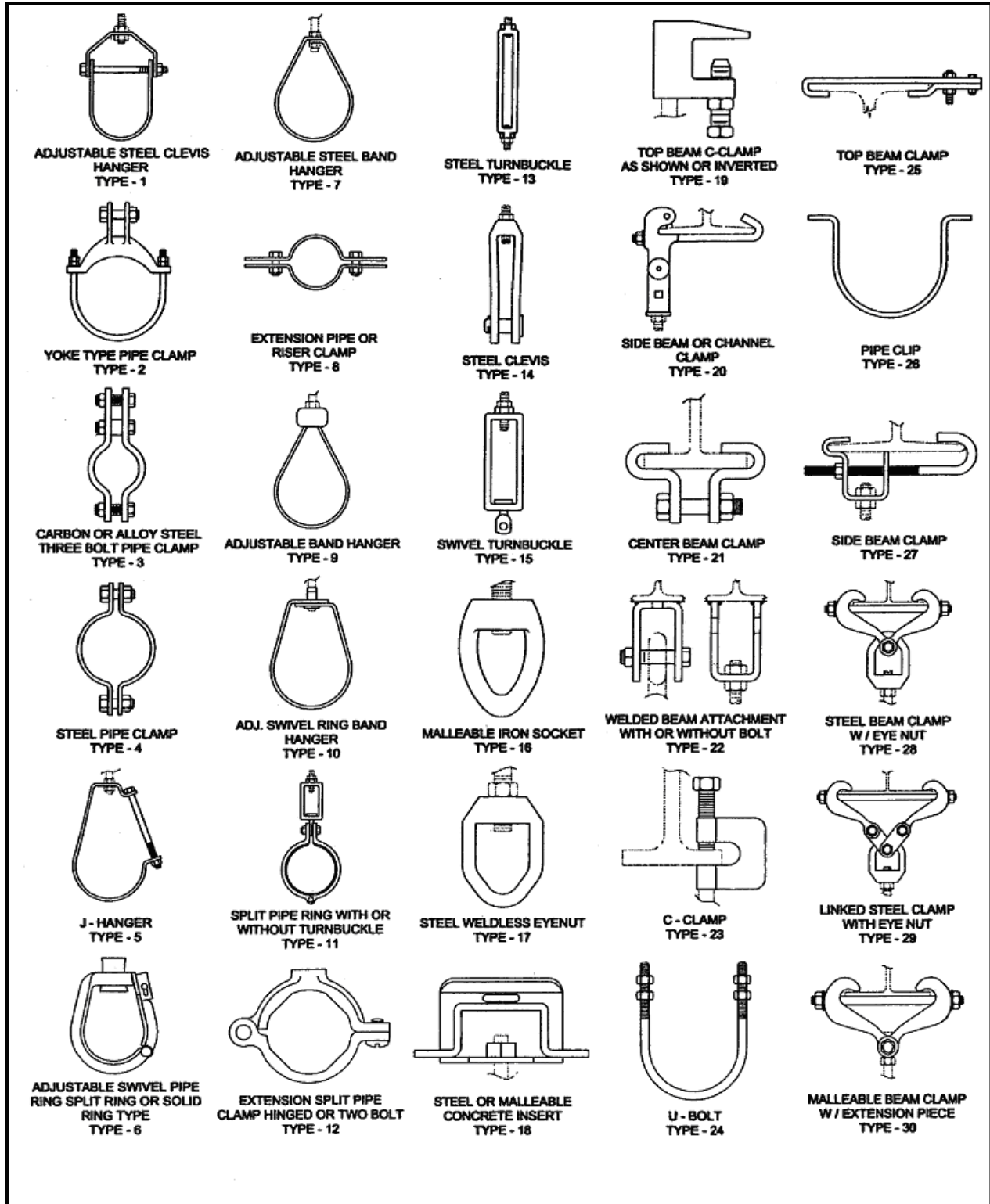
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

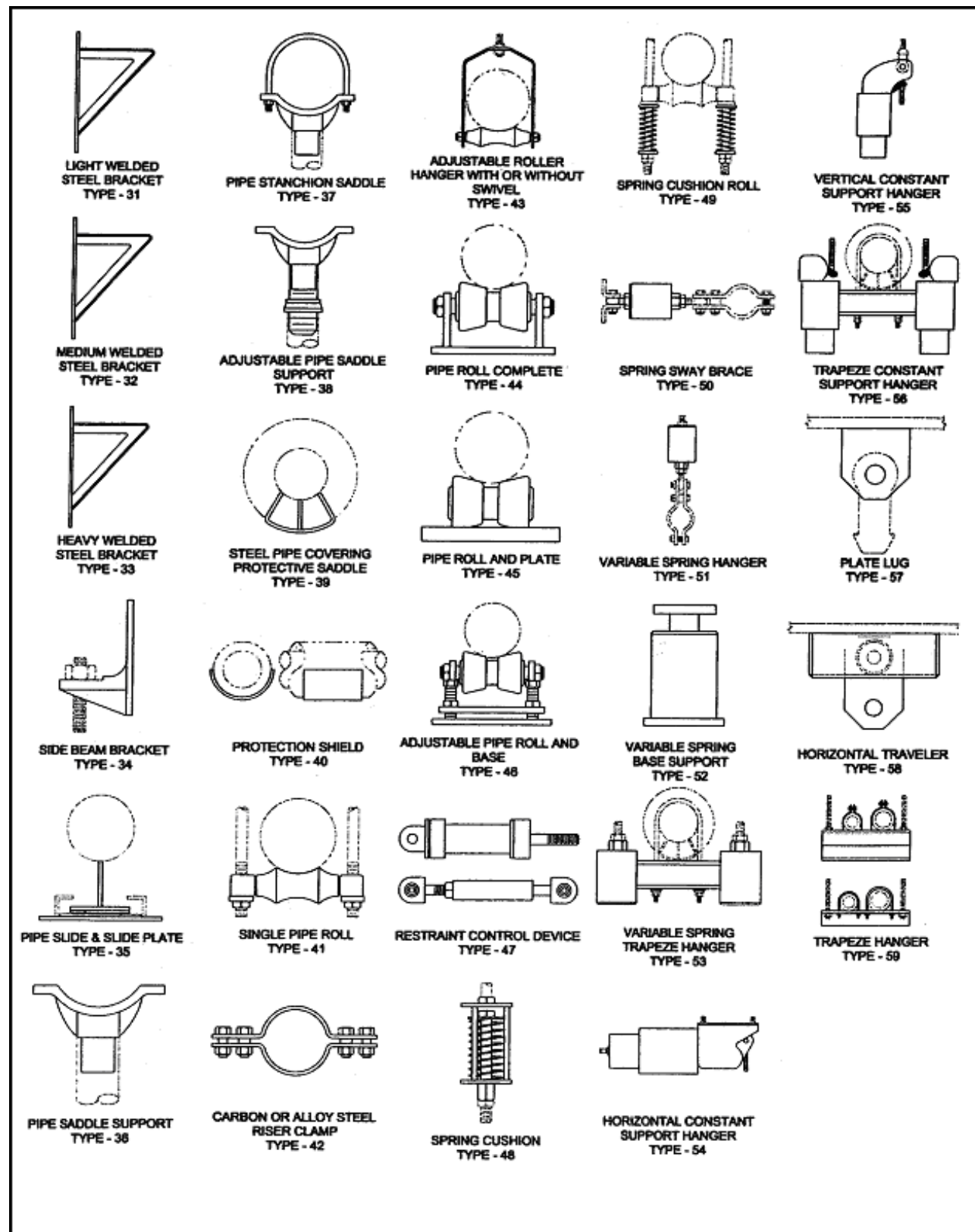
1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Metal pipe hangers and supports.
 - 2. Fiberglass pipe hangers.
 - 3. Fastener systems.
 - 4. Pipe stands.
 - 5. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 22 Section "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports", refer to the following figures when the "Type" hanger or support is indicated in Part 2 and 3 of this specification.





1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers, pipe hangers utilizing structural steel members, and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Refer to section 220500 'Common Work Results for Plumbing' for any corrosive items or locations this project may contain.
- C. General: Hangers and supports for piping and equipment shall withstand the effects of loads and stresses within limits and under conditions indicated according to ASCE 7. Design piping and equipment supports, including pipe stands, to support combined loads of supported systems, equipment and system contents.
- D. Delegated Design for Wind Loads: Exterior equipment and associated mounting assemblies, exterior piping, and the attachment to structure shall meet the wind structural loading requirements of the local Building Codes and Authorities Having Jurisdiction.
 - 1. Wind Design Pressures: As determined from wind speed, building category, wind exposure indicated on the structural drawings for specific equipment location calculated per the structural wind loading requirements of the Building Code.
 - 2. Structural Attachment Forces: As determined from wind design pressures using actual equipment dimensions calculated per the structural wind loading requirements of the Building Code.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for shop and field fabricated pipe and equipment support systems.

1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.7 DESIGN CRITERIA

- A. When this specification includes both insulation protection shields and thermal pipe shields, the Contractor may use either device, coordinated with insulation specifications.
- B. Contractor is responsible for proper placement of supporting devices to accommodate insulation and pitching of pipe as specified in other sections.
- C. Where piping can be conveniently grouped to allow the use of trapeze type supports, the supporting steel shall be by means of standard structural shapes or continuous insert channels.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer; all items made of carbon steel.

B. 316 Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer; all items made of 316 stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer; all items made of stainless steel.

2.2 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are each made of polyurethane or 316 stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts; all items made of 316 stainless steel.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Stainless anchors shall be used in exterior or corrosive interior applications.

2.4 PIPE STAND

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support floor or roof-mounted piping.
 - 1. Floor stands shall be secured to the floor with 316 stainless steel hardware.
- B. Pipe Stands Zero Roof Penetration Type:
 - 1. Compact Pipe Stand: One-piece base unit with rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 2. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
 - 3. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - a. Base: Plastic, Stainless steel, or rubber.
 - b. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - c. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
 - 4. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - a. Bases: One or more plastic or rubber.
 - b. Vertical Members: Two or more stainless-steel channels.
 - c. Horizontal Member: Stainless-steel channel.
 - d. Pipe Supports: Stainless-steel, clevis-type pipe hangers.
 - 5. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
 - 1. HOLDRITE Corp.; Hubbard Enterprises.

2.6 EQUIPMENT SUPPORTS

- A. Provide all supporting steel, not indicated on the structural drawings, that is required for the installation of plumbing equipment, piping and materials, including angles, channels, beams, etc., to suspend or floor support piping and equipment.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

PART 3 - EXECUTION

3.1 UNDERGROUND

- A. All piping below ground shall utilize 316 stainless steel hangers, cable and/or hardware (equal to Gripple) to support the piping buried in the dirt. These shall be installed prior to the concrete pour of the ground floor. The support is such so that should there be significant erosion from a hurricane, tidal surge, etc., that the piping will remain intact even if the dirt/sand below the building is partially washed away. The hanger spacing shall be equal to that for piping hung in the ceiling space. The stainless steel cables shall be tied to the rebar in the concrete pour.

3.2 HANGER AND SUPPORT APPLICATIONS

- A. Use zinc coated carbon-steel hangers, supports, and attachments for general service applications.
- B. Use hangers and supports with galvanized, metallic coatings for piping and equipment exposed to weather/moisture and that will not have field-applied rust preventative finish.
- C. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- D. Use padded hangers for piping that is subject to scratching.
- E. Use thermal-hanger shield inserts for insulated piping and tubing.
- F. Comply with MSS SP-69 for pipe hanger and support selections and applications that are not specified in piping system Sections.
- G. Plastic coated or copper-plated hangers shall be provided for copper piping in direct contact with hangers. Use padded hangers for piping that is subject to scratching.
- H. Horizontal-Piping Hangers: Unless otherwise indicated, install the following types:
 - 1. Adjustable, Clevis Hangers (MSS Type 1): For suspension of individual piping
 - 2. Loop Hangers (MSS Type 7) for piping NPS 3 and below are only acceptable when the ceiling space is such that the clevis hangers (MSS Type 1) will not fit in the available space.

- I. Horizontal-Piping Supports: Unless otherwise indicated, install the following types when supporting pipe from below either in equipment rooms or at exterior locations:
 - 1. Adjustable, Pipe Stanchion Saddles (MSS Type 38): For support of individual pipes, with adjustable steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 - 2. Adjustable, Pipe Saddle Supports (MSS Type 37): For support for individual pipes, NPS 2 to NPS 8, with all thread rod for height adjustment and U-bolt to retain pipe.
 - 3. Pipe rails or Pipe Stands: For support of multiple horizontal piping.
 - a. Rail or stand support selected and sized for associated loads suitable for mounting each pipe with (MSS Type 24) standard U-Bolt pipe strap, strut mounted pipe guide or (MSS Type 41 or 44) pipe roller.
 - b. Pipe strap (MSS Type 24) for all systems NPS 1 1/2 and smaller.
 - c. Pipe strap (MSS Type 24) for ambient and cold systems (119 deg F and below) NPS 2 and above.
 - 4. Utilize individual adjustable type pipe support for piping which requires a specific slope.
- J. Vertical-Piping Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
 - 3. Piping larger than 4", of lengths exceeding 30 feet, shall be additionally supported on base elbows secured to the building structure, with flexible supporting hangers, provided at top of riser to allow for pipe expansion.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Comply with MFMA-102 for all metal framing system selections and applications.
- N. Support of pipe, tubing and equipment shall be accomplished by means of engineered products, specific to each application. Makeshift, field devised methods are not allowed.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- C. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 3. Install anchors for metal decking and wood forms prior to the concrete pour according to the manufacturer's instructions.

D. Pipe Stand Installation:

1. Pipe Stands: Assemble stand components and secure to roof, equipment room, or equipment yard concrete slab.
2. Roof Curb or Rail Mounted Type: Assemble stand components and secure to roof curb or rail.
3. Provide insulation shields, support types and slope in accordance with specified requirements.

E. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, backing plates and other accessories.

G. All vertical risers shall be supported at each floor with riser clamp.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

- a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
- b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
- c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

- a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

- b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
- 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
- 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- 7. Hangers shall be installed outside on insulated piping with protection for insulation provided by shields or saddles. Shields or saddles shall be sized to prevent depression of insulation as recommended by insulation manufacturer. However insulated drainage pipe shall have the hanger support on the pipe to insure proper pitch.
- M. No-hub pipe and fitting coupling joints that are exposed to thrust pressures greater than those recommended by the pipe and fitting manufacturer shall receive auxiliary support by means of appropriate bracing materials, as referred to in CISPI Designation 310-04, 301-09, 301-12, the CISPI Cast Iron Soil Pipe and Fittings Handbook, and the applicable plumbing code. Auxiliary restraint products used shall be manufactured assemblies with thrust pressure rating adequate for the specific installation and shall be installed onto horizontal joints NPS 4 diameter and larger in size. Field devised methods and materials shall not be used to accomplish this application solution. Restraints shall be equal to that manufactured by Holdrite #117.
- N. Provide support for all p-traps NPS 4 and larger in size.
- O. Exposed copper piping within a commercial kitchen (both for supply and for waste) shall utilize copper supports. Any exposed stainless steel supply piping within the commercial kitchen shall utilize 304 stainless steel for all supports and hardware.

3.4 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

3.6 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.7 PAINTING

- A. Touch Up: Clean field welds, bolted connections and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.8 SPACING

- A. Refer to individual piping sections for spacing requirements.
- B. Where no requirement is specified elsewhere, pipe hangers and supports shall be per MSS SP-90.
- C. Space pipe hangers and supports in accordance with following tables, with exceptions as indicated herein.
- D. The vertical spacing shall be at each floor level, with spacing not to exceed that shown in the table below. Provide mid story guides on PEX, PVC, PP, and CPVC piping per local code requirements.

Table 1 – Maximum Horizontal Pipe Hanger and Support Spacing

NOMINAL PIPE OR TUBE SIZE		1		2		3		4		5	6	7	8	9	10	11	12	13
		STD WT STEEL PIPE				COPPER TUBE				CSST	DUCTILE IRON PIPE	CAST IRON SOIL	PEX	PLASTIC PVC	PLASTIC CPVC 1" AND SMALLER	PLASTIC CPVC 1-1/4" AND LARGER	PLASTIC PP 1" AND SMALLER	PLASTIC PP 1-1/4" AND LARGER
		WATER SERVICE		VAPOR SERVICE		WATER SERVICE		VAPOR SERVICE										
in.	mm	ft.	m	ft.	m	ft.	m	ft.	m									
1/4	(6)					5	1.5	4	1.2	FOLLOW REQUIREMENTS OF THE PIPING MANUFACTURER.	10 FT. (3.0m) MAX SPACING.	5 FT. (3.0m) MAX SPACING EXCEPT MAY INCREASE TO 10 FT. WHERE 10 FOOT LENGTHS ARE INSTALLED. MIN OF ONE (1) HANGER PER PIPE SECTION CLOSE TO JOINT ON THE BARREL. ALSO AT CHANGE OF DIRECTION AND BRANCH CONNECTIONS.	3/2 IN. (813mm) MAX. SPACING.	4 FT. (1.22m) MAX SPACING.	3 FT. (.91m) MAX. SPACING.	4 FT. (1.22m) MAX. SPACING.	3/2 IN. (813mm) MAX. SPACING.	4 FT. (1.22m) MAXIMUM SPACING.
3/8	(10)	7	2.1	6	1.8	5	1.5	4	1.2									
1/2	(15)	7	2.1	6	1.8	5	1.5	4	1.2									
3/4	(20)	7	2.1	8	2.4	5	1.5	6	1.8									
1	(25)	7	2.1	8	2.4	6	1.8	8	2.4									
1-1/4	(32)	7	2.1	10	3.0	6	2.1	8	2.4									
1-1/2	(40)	9	2.7	10	3.0	8	2.4	8	2.4									
2	(50)	10	3.0	10	3.0	8	2.4	8	2.4									
2-1/2	(65)	11	3.4	10	3.0	9	2.7	8	2.4									
3	(80)	12	3.7	10	3.0	10	3.0	8	2.4									
3-1/2	(90)	12	3.7	10	3.0	10	3.0	8	2.4									
4	(100)	12	3.7	10	3.0	10	3.0	8	2.4									
5	(125)	12	3.7	10	3.0	10	3.0	8	2.4									
6	(150)	12	3.7	10	3.0	10	3.0	8	2.4									
8	(200)	12	3.7	10	3.0	10	3.0	8	2.4									
10	(250)	12	3.7	10	3.0	10	3.0	8	2.4									
12	(300)	12	3.7	10	3.0	10	3.0	8	2.4									
14	(350)	12	3.7	10	3.0													
16	(400)	12	3.7	10	3.0													
18	(450)	12	3.7	10	3.0													
20	(500)	12	3.7	10	3.0													
24	(600)	12	3.7	10	3.0													
30	(750)	12	3.7	10	3.0													
Vertical Spacing		15	4.5	15	4.5	10	3.0	10	3.0	Per manufacturer	15' (4.5m)	15' (4.5m)	10' (3.0m)	10' (3.0m)	10' (3.0m)	10' (3.0m)	10' (3.0m)	10' (3.0m)

		COLUMNS ⁽³⁾ 1, 2, 6, 7		COLUMNS ⁽³⁾ 3, 4, 9, 10, 11, 12, 13	
NOMINAL PIPE OR TUBING SIZE		NOMINAL ROD DIA.		NOMINAL ROD DIA.	
in	mm	in	mm	in	mm
1/4	(6)			3/8	M10
3/8	(10)	3/8	M10	3/8	M10
1/2	(15)	3/8	M10	3/8	M10
3/4	(20)	3/8	M10	3/8	M10
1	(25)	3/8	M10	3/8	M10
1-1/4	(32)	3/8	M10	3/8	M10
1-1/2	(40)	3/8	M10	3/8	M10
2	(50)	3/8	M10	3/8	M10
2-1/2	(65)	1/2	M12	1/2	M12
3	(80)	1/2	M12	1/2	M12
3-1/2	(90)	1/2	M12	1/2	M12
4	(100)	5/8	M16	1/2	M12
5	(125)	5/8	M16	1/2	M12
6	(150)	3/4	M20	5/8	M16
8	(200)	3/4	M20	3/4	M20
10	(250)	7/8	M22	3/4	M20
12	(300)	7/8	M22	3/4	M20
14	(350)	1	M24		
16	(400)	1	M24		
18	(450)	1	M24		
20	(500)	1-1/4	M30		
24	(600)	1-1/4	M30		
30	(750)	1-1/4	M30		
NOTE: (1) For calculated loads, rod diameters may be sized in accordance with MSS SP-58, Table 3 provided Table 1 and Section 7.3 of MSS SP-58 are satisfied. (2) Rods may be reduced one size for double rod hangers. Minimum rod diameter shall be 3/8 in. (M10). (3) Columns noted refer to Table 1, maximum horizontal pipe hanger and support spacing.					

END OF SECTION 220529

SECTION 220550 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes items for structural vibration isolation and includes the following:
 - 1. Mounts.
 - 2. Bases.
 - 3. Hangers.
 - 4. Restraints.
 - 5. Anchors and guides.
 - 6. Flexible pipe connections.

1.3 ACTION SUBMITTALS

- A. Product Data: Provide schedule and product data of isolation devices related to the equipment served. Schedule and data shall indicate isolation materials, isolator heights both free and operating, isolator dimensions, deflections, and isolation efficiency based on lowest operating speed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Products and methods of fabrication, subject to compliance with requirements, provide products by one of the following:
 - 1. Mason Industries
 - 2. Korfund Company
 - 3. Amber-Booth Company
 - 4. Consolidated Kinetics Corporation

2.2 MATERIALS

- A. All isolation devices shall be designed for the equipment with which they will be used. Materials used shall retain their isolation characteristics for the life of the equipment served. All elastomeric materials shall be industrial grade neoprene. Isolation devices subject to weather shall have hot dipped galvanized finish.

2.3 TYPE 1 MOUNTS

- A. Mason type ND or rails type DNR, double deflection neoprene mounts with cast-in metal inserts for bolting to equipment, and shall have a minimum static deflection of 0.35".

2.4 TYPE 2 MOUNTS

- A. Both surfaces shall be rib molded for skid resistance. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang.

2.5 TYPE 3 MOUNTS

- A. Mason type SLF, combination spring and neoprene with rib molded base. Spring type isolators shall be free standing and laterally stable without any housing, and complete with 1/2" neoprene acoustical friction pads between the baseplate and the support.
- B. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load.

2.6 TYPE 4 MOUNTS

- A. Mason type SLR, combination spring and neoprene with rib molded base similar to type 2 above, but shall have a housing that includes vertical limit stops to prevent springs extension when weight is removed.
- B. The installed and operating heights shall be the same. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation.

2.7 TYPE 5 MOUNTS

- A. Mason type W pads shall be bridge bearing neoprene, 3/4" thick minimum. Pads shall be oil resistant.

2.8 TYPE S BASES

- A. Mason type WF, structural steel bases, rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10 of the longest dimension of the base. Beam depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of two inches. Example of call-out "3-S."

2.9 TYPE I BASES

- A. Mason type K, rectangular structural beam or channel concrete forms for floating foundations. Base for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.
- B. Bases shall be a minimum of 1/12 of the longest dimension of base, but not less than 6". Forms shall include minimum concrete reinforcement consisting of 1/2" bars, or angles welded in place, on 6" centers running both ways in a layer 1-1/2" above the bottom or additional steel as is required by the structural conditions. Forms shall be furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts where anchor bolts fall in concrete locations. Height saving brackets shall be employed in all mounting locations to maintain a 2" clearance below the base. Example of call-out "3-I."

2.10 TYPE 5 HANGERS

- A. Mason type 30N, vibration hangers with a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degrees arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

2.11 TYPE 6 HANGERS

- A. Mason type PC30N, vibration hangers similar to type 4, but precompressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. Design hangers with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load.

2.12 TYPE 7 HANGERS

- A. Mason type HES, a steel spring in a steel housing and include a deflection indicator scale. Hangers shall be preset at the factory for the required load. Hangers shall be capable of 130%

of rated deflection, but no more than 100% of rated deflection shall be used when selecting the hanger.

- B. Submittals shall include isolator rated deflection, required deflection, and supporting calculation. Calculations shall be made by a registered mechanical or civil engineer demonstrating the structural adequacy of the hanger and that its connections to the building and the pipe are adequate for the live and dead loads encountered.

2.13 TYPE 8 HANGERS

- A. Mason type W30, a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. Neoprene cup to contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole size to be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs to have a minimum additional travel to solid equal to 50% of the rated deflection. Provide hangers with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps.

2.14 TYPE AG PIPE ANCHORS AND GUIDES

- A. Shall be directional acoustical pipe anchors and guides for vertical piping consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material. Vertical restraints shall prevent vertical travel in either direction. Allowable loads on the isolation materials shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.
- B. Submittals shall include supporting calculations by a registered mechanical or civil engineer indicating anchor/ guide loads and isolator selection.
- C. Pipe anchors and guides for vertical piping shall be Mason type ADA or ADAH or similar by other manufacturers listed.

2.15 TYPE T THRUST RESTRAINTS

- A. Mason type WB, horizontal thrust restraint consisting of a spring element in series, with a neoprene pad as described for type 2 mounts with the same deflection as specified for the mountings or hangers. The spring element shall be contained within a steel frame and designed so it can be present for thrust at the factory and adjusted in the field for a maximum of 1/4" movement at start and stop. Furnish thrust restraints complete with rods and angle brackets for attachment to both the equipment and ductwork or equipment and structure. Attach horizontal restraints at the centerline of thrust and symmetrically on either side of the unit.

2.16 FLEXIBLE PIPING CONNECTIONS

- A. Provide flexible connections for all piping to equipment mounted on vibration isolators and all piping connected to rotating or reciprocating equipment.
- B. Flexible connection shall be suitable for pressure, temperature and fluid involved.

- C. Minimum line length of flexible hose shall be 12" or length required to absorb 3/4" lateral movement, whichever is longer.
- D. Piping connected to a coil which is in an assembly mounted on vibration isolators is to have flexible piping connections and piping vibration hangers as specified below. Piping connected to a coil which is in an assembly where the fan is separately isolated by means of vibration isolators and duct flexible connections does not require flexible piping connectors or piping vibration hangers.
- E. Water and/or Pumped Condensate System:
 - 1. Flexible pipe connections shall be molded teflon bellows with flange connections and rubber isolated restraining bolts in systems where extreme chemical resistance is required or short flange to flange dimensions are required. Otherwise, flexible pipe connections shall be reinforced molded rubber double sphere expansion joints for 2-1/2" and over, double sphere union type with control cables for 2" and smaller.
 - 2. Flexible pipe connections Metraflex or Mason-Flex equal to Mason MF series with type ACC control cable assemblies where required.
 - 3. Connections shall consist of multiple plies of nylon tire cord fabric and neoprene both molded and cured in hydraulic rubber presses. No steel wire or rings shall be used as pressure reinforcement. 2" and smaller may have threaded connections; 2-1/2" and larger shall have floating class 150 lb. steel flanges recessed to lock the raised face of the neoprene connection flange.
 - 4. Construct all straight through connections with twin spheres properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure. 12" and larger sizes operating above 100 psi, shall employ control cables with end fittings isolated by means of 1/2" thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.
- F. Steam and Condensate System:
 - 1. Seamless corrugated bronze flexible hose with braided cover for 2" and smaller and seamless corrugated stainless steel flexible hose with braided cover for 2-1/2" and larger.
- G. Fuel Oil System:
 - 1. Seamless corrugated bronze flexible hose with braided cover.
- H. Do not provide flexible piping connectors for the following systems:
 - 1. Gas piping

2.17 PERFORMANCE

- A. Select all vibration isolation devices to provide minimum 95% isolation efficiency or based on the minimum static deflection and mounting criteria listed below, whichever is greater:

Equipment Type	Floor Span							
	<u>On Grade</u>		<u>20-Feet</u>		<u>30-Feet</u>		<u>40-Feet</u>	
	Min.		Min.		Min.		Min.	
	Type	Stat. Defl. In.	Type	Stat. Defl. In.	Type	Stat. Defl. In.	Type	Stat. Defl. In.
Boilers	1	0.10	4	0.75	4	0.75	4	1.5
Pumps								
Close Coupled								
through 5 hp	2-I	0.35	3-I	0.75	3-I	0.75	3-I	0.75
7 1/2 hp & over	3-I	0.75	3-I	0.75	3-I	1.5	3-I	1.5
Flexible Coupled								
through 40 hp	3-I	0.75	3-I	0.75	3-I	1.5	3-I	1.5
50 hp & over	3-I	0.75	3-I	1.5	3-I	2.5	3-I	2.5
Air Compressors through 3HP	3	1.0	3-I	1.5	3-I	2.5	3-I	3.5
5HP & over	3-I	1.0	3-I	1.5	3-I	2.5	3-I	3.5
Piping connected to rotating or reciprocating equipment	Use flexible piping connections, and type 5 or 6 hangers for a distance of 100 pipe diameters or a distance of three hangers away from the equipment, whichever is greater.							
Vertical pipe risers greater than 30 feet in height.	Use type 7 hangers at the top of the riser and type AG with pipe clamps at intermediate points.							

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate the selection of devices with the isolator and equipment manufacturer.
- B. Isolate all motor driven mechanical equipment, unless otherwise noted, from the building structure, and from the systems which they serve, to prevent equipment vibrations from being transmitted to the structure.
- C. Consider equipment weight distribution to provide uniform deflections.

- D. For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.
- E. Install vibration isolation devices as specified, as shown on the drawings and according to the manufacturer's instructions.
- F. In no case shall the installation short circuit the isolation device. Flexible piping connections are to be installed on the equipment side of shut-off valves.

END OF SECTION 220550

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Valve tags.

1.3 QUALITY ASSURANCE

- A. All tags and labels for medical gas piping systems shall be according to NFPA 99.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black. Red shall be used if the equipment is on emergency power.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 1-1/2 inch.

6. Minimum Letter Size: 1/2 inch Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Ceiling Grid Labels for concealed equipment and valves:
1. Coordinate label style (e.g. Kroy/P-Touch tape, color coded dots, etc.) with architect and owner.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules).
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper, tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Color and Lettering Size: Conform to ANSI/ASME A13.1-2015 standards.
- D. Basis of Design manufacturer: Seton

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers. Valves shall be tagged per the chart below.

PIPING

VALVES

1. Cold Water	CW-1, CW-2, CW-3, etc.
2. Hot Water (Domestic)	HW-1, HW-2, HW-3, etc.
3. Hot Water Return (Domestic)	HR-1, HR-2, HR-3, etc.

4. Fuel Gas

GAS-1, GAS-2, GAS-3, etc.

1. For the systems not listed above, a similar naming strategy shall be utilized.
 2. Tag Material: Brass, 0.032-inch minimum thickness, 1-1/2" minimum diameter and having predrilled or stamped holes for attachment hardware.
 3. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper, tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.
 2. Furnish a typewritten framed chart under glass indicating fixtures or areas supplied by each number valve and mount same as directed by Owner or Architect.
- C. Ceiling Identification: Provide color coded dots on accessible ceiling grid to identify the location of valves mounted above the ceiling.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. All backflow preventers, vacuum breakers, mixing valves, hose stations, and trap primer manifolds shall also be labeled.
- D. In addition to installing labels on each major item of mechanical equipment, adhesive labels shall be located on ceiling grids directly below equipment concealed in ceilings. Labels shall also be installed for all branch shutoff valves.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09. In the absence of specific requirements to the contrary in Division 9, all exposed equipment, piping, hangers, etc., shall be painted by the Contractor. Confirm with Owner the color scheme prior to commencing with painting. Unless otherwise directed, exposed piping shall be painted to match the

structure and/or the surrounding areas. Should the Owner want each system shall be painted per system, follow the below schedule:

<u>SYSTEM</u>	<u>COLOR</u>
Domestic Hot Water	Yellow
Domestic Cold Water	Green
Sanitary Waste and Vent	Brown
Fuel Gas	Yellow

- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 7. At least once in each room.
 8. At each location where exposed piping passes through walls and floors.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on all valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; equipment shut-off valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials
 - 2. Adhesives.
 - 3. Sealants.
 - 4. Factory-applied jackets.
 - 5. Field-applied jackets.
 - 6. Tapes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. All insulation materials furnished shall meet the minimum thickness requirement of ASHRAE standard 90.1.
- E. Insulation materials for use on stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Type 'R': Rigid (Molded) Fibrous glass, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Insulation without factory applied jacket shall be used in locations where field applied jackets are specified.
 - 2. Products:
 - a. Owens Corning; Fiberglas Pipe Insulation SSL II-ASJ
 - b. Johns Manville; Micro-Lok
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber and ASJ Adhesive: Comply with ASTM C916 Type I/II for bonding insulation jacket lap seams and joints.
 - 1. Products:
 - a. Childers Products, H.B. Fuller Construction Products; CP-127 or CP-82.
 - b. Foster Products, H. B. Fuller Construction Products; 85-20 or 85-60.
 - c. Mon-Eco Industries, Inc.; 22-25.
- C. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products:
 - a. Dow Chemical Company; 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. Speedline Corporation; Polyco VP Adhesive.

2.3 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products:
 - a. Childers Products, H.B. Fuller Construction Products; CP-76 or CP-70.
 - b. Foster Products, H. B. Fuller Construction Products; 30-45 or 95-50.
 - c. Pittsburgh Corning Pittseal 444
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 200 deg F.
5. Color: White, tan, or gray.

2.4 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.5 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, ; roll stock ready for shop or field cutting and forming thickness as scheduled.

1. Products:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
2. Adhesive: As recommended by jacket material manufacturer.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
4. Factory-fabricated tank heads and tank side panels.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- N. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.
- O. All hot water piping shall be insulated up to every fixture stop.
- P. Install protective shielding guards on each ADA lavatory and sink with exposed supplies and/or trap/drain piping. Guards shall be installed on the hot and cold water supplies as well as the drain piping.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions while complying with firestopping requirements.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 EQUIPMENT INSULATION INSTALLATION

- A. All equipment connected to the hot water system shall be insulated to include recirculation pumps, mixing valves, heat exchangers, storage tanks and water heaters.
- B. Products/equipment that is provided with a pre-formed insulation shell, to include (but not limited to) balancing valves and circulation pumps, shall have it installed per the manufacturer's recommendations.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable

- insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- E. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- F. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant. Secure jacket with stainless-steel bands 12 inches on center and at end joints.

3.7 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections. Paint two coats with a flat acrylic finish over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces and other uninsulated building elements where the piping is not subject to freezing.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
- C. All piping and equipment shall be insulated per the table below:

Service	Maximum Allowed Conductivity (Btu*in/(hr* ft ² *F))	Insulation Type	Insulation Thickness According to Pipe Size			
			½" – ¾"	1" – 1 ¼"	1 ½"	2" and Larger
Above Grade/Slab Hot Water and Hot Water Return 105-140°F	0.28	R	1	1	1-1/2	1-1/2
All Water Pipe in Exterior Walls	N/A	R	Thickness shall be 1" unless indicated elsewhere in this table.			
Cold Water	N/A	R	1	1	1	1
Pipe in Mechanical Rooms	N/A	The insulation type and thickness shall be as stated in this chart depending on service and pipe size. However, all of the insulation shall be provided with a PVC jacket.				

3.9 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Piping, Concealed: None.
- C. Piping, Exposed:
 - 1. PVC: 20 mils thick.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Domestic water piping and fittings inside the building and beneath the building slab.
 - 2. Domestic water piping and fittings for the water service entrance.
 - 3. Encasement for piping.

1.3 ACTION SUBMITTALS

- A. Product Data: Piping materials including joining materials/methods.
- B. Shop Drawings. Include plans, elevations, sections, and details.

1.4 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner unless permitted in writing by the Owner only after arranging to provide temporary water service.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Plastic piping components shall be marked with "NSF-pw."
 - 1. All plumbing components, including but not limited to piping, valves, backflow preventers, fixtures, etc that are connected to the domestic water system which convey water to be used for human consumption shall meet the NSF-372, 'Lead-Free' requirements. Items not intended to dispense water for human consumption such as

flush valves, tub fills, shower valves, or piping accessories connected to non-potable water systems, are not required to meet the 'Lead Free' requirements.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper, for above ground applications. Below ground applications shall be ASTM B 88, Type K water tubing.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

- A. Refer to Section 220500 for materials common to multiple specification sections.

2.4 COPPER PIPE SLEEVE

- A. Material: 10 mil. Polyethylene sleeve for protection in concrete pour.
 - 1. Piping shall be cleaned prior to installation. Extend sleeve 6" above floor level. Tape ends shut to prevent entry of debris. Sleeve shall be installed on all copper piping passing through concrete floors and walls.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, and pressure gage, inside the building at each domestic water service entrance.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, couplings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install unions at final connection to each piece of equipment, machine, and specialty. Install shut-off valves on the upstream side of the upstream union and downstream of the downstream union on each piece of equipment. Unions and flanges for servicing and disconnections are not required in installations with grooved mechanical joint couplings as the couplings shall serve as the disconnect points.
- L. Plastic piping shall not be installed in return air plenums unless specifically listed for use in plenums.
- M. The system installation shall include all connections to plumbing fixtures, each piece of equipment and all equipment furnished under other contracts.
- N. Piping shall be installed with necessary swing joints and offsets to properly allow for expansion in addition to expansion joints. Provide dielectric unions between steel and copper connections when copper pipe is installed.
- O. Install all water pipe by use of proper pipe and fitting materials. All changes in pipe size shall be by use of reducing fittings. Bushings shall not be used.
- P. All hot water systems shall be balanced by the contractor to ensure proper flow through each recirculating leg of the system including all mains back to the recirculation pump.
- Q. Piping is to run in the center of stud cavity wherever possible.
- R. Do not install water piping in electrical rooms, tele/data rooms, transformer rooms, audio/visual rooms, or elevator equipment rooms.
- S. All piping shall be run full size as indicated on the drawings up to the equipment/fixture/device that it serves. Any change in size required for connection shall be made immediately adjacent to that equipment. All valves, unions, and associated devices serving the equipment shall be the same size as the pipe size indicated on the drawings serving that equipment.
- T. Do not install tee fittings such that they are in the 'bullhead' orientation.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel and CPVC pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads. Refer to CPVC pipe manufacturer's recommendations for acceptable thread compounds. PTFE tape is acceptable for use with CPVC pipe.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- H. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- C. Piping tests shall be performed per the requirements of the authority having jurisdiction. If the AHJ has no specific requirements, perform the following at a minimum:
 - 1. Flush all piping prior to testing.
 - 2. Fill domestic water piping with water. Check components to determine that they are not air bound and that piping is full of water.
 - 3. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 4. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 5. Cap and subject piping to static water pressure of 100 psig above operating pressure, without exceeding pressure rating of piping system materials for 24 hours. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - a. Note: Some manufacturers of various system components, such as press fittings, require a lower pressure test. Should the contractor install any system components that the manufacturer specifically requires a lower pressure test, this shall be completed prior to that indicated here. The manufacturer's testing requirements shall be adhered to.
 - 6. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 7. Prepare reports for tests and for corrective action required.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open throttling valves to proper setting.
3. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Adjust calibrated balancing valves to flows indicated.
 - b. Provide a separate balancing report indicating the adjusted water balance flows.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.5 CLEANING

A. Clean and disinfect domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction, should it be mandated by them. Repeat procedures if biological examination shows contamination.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction, should it be mandated by them. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.6 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Above-ground domestic water piping, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved joints (for piping NPS 2-1/2 and larger).
 3. Soft copper tube shall only be permitted on equipment connections (e.g. ice machines).

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Backflow preventers.
 - 2. Balancing valves.
 - 3. Water mixing valves.
 - 4. Strainers.
 - 5. Drain valves.
 - 6. Water hammer arresters.
 - 7. Air vents.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, and pressure gages in domestic water piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Items connected to the domestic water system shall be in compliance with NSF 61. Any plastic components connected to the domestic water system shall be in compliance with NSF 14.
 - 1. All plumbing components, including but not limited to piping, valves, backflow preventers, fixtures, etc., that are connected to the domestic water system which convey water to be used for human consumption shall meet the NSF-372, 'Lead-Free' requirements. Items not intended to dispense water for human consumption such as flush valves, tub fills, shower valves, or piping accessories connected to non-potable water systems, are not required to meet the 'Lead Free' requirements.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers shall meet ASSE 1013 with either bronze or stainless steel body (equal to that specified on the drawings), rated for continuous pressure applications, with ball or OS&Y valves on the inlet and outlet, and provided with an air gap fitting per ASME A112.1.2. On those located indoors, route the discharge from the air gap to the nearest floor receptor.
 - 1. Manufacturers: Apollo Valve, FEBCO, Watts Industries, Mifab Wilkins.
- B. Backflow-preventer test kits shall be factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions:
 - 1. Manufacturers: Apollo Valve, FEBCO, Watts Industries, Wilkins.

2.2 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
 - 1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. ITT Industries; Bell & Gossett Div.
 - c. NIBCO INC.
 - d. Watts Industries, Inc.; Water Products Div.
 - 2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
 - 3. Body: bronze.
 - 4. Size: Same as connected piping, but not larger than NPS 2.
 - 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

- B. Accessories: Provide owner with one meter kit consisting of meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Thermostatic, Water-Mixing-Valves:

1. Manufacturers:

- a. Armstrong International, Inc.
- b. Bradley Corporation
- c. Leonard Valve Company.
- d. Powers; a division of Watts Water Technologies, Inc.
- e. Symmons Industries, Inc.
- f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

- 2. Standard: ASSE 1017.
- 3. Pressure Rating: 125 psig.
- 4. Type: Thermostatically controlled, water mixing valve.
- 5. Material: Bronze body with corrosion-resistant interior components.
- 6. Connections: Threaded union inlets and outlet.
- 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
- 8. Tempered-Water Setting shall be listed on the drawings.
- 9. Refer to the drawings for additional information.

B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers:

- a. Bradley Corporation
- b. Leonard Valve Company.
- c. Powers; a Watts Industries Co.
- d. Symmons Industries Co.
- e. Zurn Plumbing Products Group; Wilkins Div.

- 2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
- 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
- 4. Body: Bronze body with corrosion-resistant interior components.
- 5. Temperature Control: Adjustable.
- 6. Inlets and Outlet: Threaded.
- 7. Finish: Rough or chrome-plated bronze. Chrome plating shall be utilized in all exposed areas, including below sinks.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 60 mesh.
 - b. Strainers NPS 2-1/2 to NPS 4: 12 mesh.
 - c. Strainers NPS 5 and Larger: 8 mesh.
6. Drain: NPS 1 and smaller and smaller shall have a drain plug. Larger than NPS 1 shall be provided with a shutoff valve on the discharge side for blowdown/cleaning.

2.5 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves shall meet MSS SP-110 for standard-port, two-piece ball valves and have a pressure rating of 400-psig minimum CWP.
- B. Gate-Valve-Type, Hose-End Drain Valves shall meet MSS SP-80 for gate valves and shall have a pressure rating of Class 125.
- C. Stop-and-Waste Drain Valves shall meet MSS SP-110 for ball valves or MSS SP-80 for gate valves and have a pressure rating of 200-psig minimum CWP or Class 125.

2.6 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Sioux Chief.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.
5. Manufacturer's Warranty: Life of the system. Warranty shall be equal to that of Sioux Chief.

- B. Air chambers shall not be used in lieu of water hammer arresters.

2.7 AIR VENTS

- A. Bolted-Construction Automatic Air Vents shall have a bronze body, 125-psig minimum pressure rating at 140 deg F, replaceable and corrosion-resistant metal float, stainless steel mechanism and seat, and NPS 1/2 minimum threaded inlet.

- B. Welded-Construction Automatic Air Vents shall have a stainless steel body, 150-psig minimum pressure rating, replaceable and corrosion-resistant metal float, stainless steel mechanism and seat, and NPS 3/8 minimum threaded inlet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction. Backflow preventers shall be installed in accessible locations for testing purposes.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve, backflow preventer, and pump.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each circulator pump. Set calibrated balancing valves partly open to restrict but not stop flow.
- F. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
- G. Install water hammer arresters at every fixture or battery of fixtures which have quick-closing valves (i.e. lavatories, sinks, flush valves, dishwashers, ice machines, washing machines, solenoid valves.) Install per PDI-WH 201. Access panels are not required at arrestors, unless required by the AHJ.
 - 1. Hammer arresters shall be installed directly to the header or branch piping serving the fixture(s) in which the water is flowing. Should the hammer arrester be provided with vertical nipples to elevate it above the piping (e.g. above a ceiling rather than within a wall cavity), directly under the arrester a tee and normally closed shutoff valve shall be provided on the tee to allow for bleeding the air out of the piping once the system is filled. With this installation, as the system is filled, the air will fill the vertical piping and prevent the hammer arrester from working properly unless the air is bled from the system. Access shall be provided to bleed the air out of the system.

- H. Install air vents at high points of water piping.
- I. Vacuum relief valves shall be installed on domestic hot water supply tanks, water heaters, pressure vessels as well as at the high point in the system.
- J. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- K. Install trap-seal primer manifolds with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Manifold shall be installed a minimum of 1 foot AFF for every 20 feet of horizontal primer piping.
- L. Trap primer piping shall connect directly into the drain body or through a fitting in the tailpiece. Alternately, hub drains may be provided with the trap primer piping extending directly into the top of the drain. Tapping the side of the tailpiece or drilling a hole in the tailpiece to insert the trap primer piping is not acceptable.
- M. Rough-in domestic water piping for water-meter installation and connect to the utility according to utility company's requirements. Provide shutoff valve on the inlet to the meter. Only install a bypass around the meter if required by the utility.
- N. All backflow preventers and vacuum breakers installed within a kitchen, bar, or other food service area shall either have a chrome finish or be stainless steel.
- O. Install hose bibbs and wall hydrants 18" above finished grade/floor unless noted otherwise on the drawings.
- P. Connect sub-meters to allow for remote monitoring/recording and/or billing.
- Q. Each public lavatory shall be provided with an ASSE 1070 thermostatic mixing valve set to limit the hot water supply temperature to no greater than 110 degrees F.

3.2 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each floor mounted domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves. Prepare and submit hot water balancing report.
- C. Set field-adjustable temperature set points of thermostatic mixing valves.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.

- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- B. Related Sections include the following:
 - 1. Division 22 Section "General Duty Valves for Plumbing"
 - 2. Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment"
 - 3. Division 22 Section "Sanitary Waste & Vent Piping Specialties"

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings. Include plans, elevations, sections, and details.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. Solid-Wall Schedule 40 PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.

- D. Solvent Cement: ASTM D 2564.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- B. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- C. Install sleeves and mechanical sleeve seals as indicated in Section 220500.
- D. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- E. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
 - 2. Vent Piping: Down toward fixture vent.
- G. Install PVC soil and waste drainage and vent piping according to ASTM D 2665 and underground PVC soil and waste drainage piping according to ASTM D 2321.
- H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- I. Install a complete sanitary drainage system. All soil, waste, and vent piping; connection to all plumbing fixtures, special equipment, floor drains and other equipment requiring such connections.
- J. Verify all invert elevations and measurements prior to the installation of materials, either underground, above ground, or in the building.
- K. All underground piping outside and inside the building shall be laid supported on 3" compacted bedding of sand, gravel, or crushed stone of which 100% will pass through 1/2" sieve. The bedding shall be shaped for clearance for all joints and fittings, and tamped in place,

graded evenly to insure uniform bearing for the full length of the bottom quadrant of pipe. No piping shall be supported by blocking, planking or mounding of bedding material.

1. Should the trench be over excavated, follow the above procedure in layers a maximum of 6" deep compacting after each layer.
 2. Should rock be encountered during trenching, the rock shall be removed to a minimum of 3" below the pipe placement and backfilled with bedding as described above, compacting to provide uniform load-bearing support. The pipe shall not rest on rock at any point.
 3. Should soft or poor load-bearing material be found during trenching, the trench shall be over excavated a minimum of two pipe diameters, backfilled to the level of the bottom of the pipe with fine gravel, crushed stone or a concrete foundation with a sand bedding tamped to provide uniform loading.
 4. As an option, if allowed by the AHJ, all underground piping outside and inside the building shall be laid on undisturbed compacted soil, eliminating the need for bedding.
 5. Trench backfilling shall utilize loose earth free from rocks, debris, and construction material. The backfill shall be placed in 6" increments tamped in place to provide support for the piping. Backfill shall cover the piping a minimum of 12".
- L. Install underground lines passing under foundations with minimum of 6" clearance to concrete and insure there is no disturbance of bearing soil.
- M. Above slab sanitary and vent piping shall be supported from the building structure. Under no circumstances shall piping be supported from equipment, piping or conduits within the building structure.
- N. All floor drains shall be set true and level and shall be protected properly throughout entire construction. Weep holes shall be filled with removable material, and kept free from concrete and other debris during construction. Weep holes shall be cleaned out for final working order. Safe with lead as specified. Resealing prime connections are required on all floor drains except floor drains located in showers.
- O. Trap each fixture and piece of equipment requiring drainage connections. Traps shall be set true and level and located within the limits of the code requirements. Traps shall not be used as a separator, interceptor or other type of device to retain solids. All traps shall be provided with screw type approved cleanout plugs when specified. Traps shall be protected during construction and sealed off to prevent stones, debris and other foreign matter from entering before use. When running traps are used, they shall be located for full accessibility with double cleanout.
- P. Provide plugs or caps for all opening during the construction phase. The temporary plug shall be plastic cap or equivalent. Duct tape is unacceptable for use as a plug, support or to separate ferrous from non-ferrous materials for the construction phase.
- Q. All vents through roof shall be installed a minimum of 10'-0" from all fresh air intake to air handling equipment and offset minimum of 3'-0" from edge of roof lines, parapets and all other flashing. Vent piping shall be collected so roof will be pierced a minimum number of times. Plumbing vents through roof shall be a minimum of 2 inches, or the minimum as required by code, whichever is more stringent. Vents through roof where located in a roof well, shall be extended so the vent is at an elevation above the top of the well. Vents through roof shall be painted with two coats of water based latex matching roof color.
- R. Clean-out plugs in piping shall be set with Teflon sealer or similar engineer approved equal.

- S. Contractor shall coordinate with General Contractor to ensure floor drains are level with finished floor and finished floor is sloped in all directions toward floor drain.
- T. Plastic piping shall not be used in plenum spaces unless UL listed for this application and approval is given by the AHJ.
- U. All indirect waste piping shall be terminated to be centered above the receptor opening serving it. The vertical indirect waste piping shall terminate with a mitered 45 degree cut, sloping down and away from the inside radius of the adjacent elbow. Air gaps shall be two times the indirect waste pipe diameter.

3.3 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, sanitary piping shall be any of the following:
 - 1. Solid-wall PVC-DWV pipe, PVC-DWV socket fittings, and solvent-cemented joints.
- C. Aboveground, vent piping shall be any of the following:
 - 1. Solid-wall PVC-DWV pipe, PVC-DWV socket fittings, and solvent-cemented joints.
- D. Underground, sanitary and vent piping shall be any of the following:
 - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Any drain/receptor located within the same room as a boiler that is producing temperatures above 140 degrees F, shall at a minimum be provided with metallic piping for the tailpiece and the trap.

3.4 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. During the test duration being a minimum of 15 minutes, the water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.5 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops. Duct tape is not an acceptable cap.

3.6 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

Maple Tower RAD Renovations
REW PROJECTS 07425

221316
SANITARY WASTE AND VENT PIPING

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Miscellaneous sanitary drainage piping specialties.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exterior Cleanouts (ECO):
 - 1. Manufacturers: Josam, Jay R Smith, Wade, Watts, Zurn.
 - 2. Standard: ASME A112.36.2M.
 - 3. Body Material: cast-iron.
 - 4. Closure: Countersunk, tapered threaded with gas and water tight bronze plug located within a cast iron heavy duty cleanout housing with integral concrete anchor flange and round scoriated secured cover.
 - 5. Cleanout shall be equal to Zurn Z1474-N-BP
- B. Cast-Iron Floor Cleanouts (FCO):

1. Manufacturers: Josam, Jay R Smith, Wade, Watts, Zurn.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Body Material: Cast iron.
4. Closure: Gas and watertight bronze plug with tapered threads with round scoriated secured cover.
5. Adjustable Housing Material: Cast iron with threads with shims for tilt correction.
6. Frame and Cover Material and Finish: Nickel-bronze.
7. Cleanout shall be equal to Zurn ZN1400-BZ1-BP.

C. Cast-Iron Wall Cleanouts (WCO):

1. Manufacturers: Josam, Jay R Smith, Wade, Watts, Zurn.
2. Standard: ASME A112.36.2M. Include wall access.
3. Body: cast-iron as required to match connected piping.
4. Closure: drilled-and-threaded bronze plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, stainless-steel cover plate with screw.
7. Cleanout shall be equal to Zurn Z1440-BP with Zurn Z1469.

- D. Should PVC piping be allowed and utilized, PVC bodied cleanouts are acceptable for the FCO and the WCO in lieu of those listed above, where connected to PVC piping. The floor cleanouts shall be provided with ABS threaded plug with a nickel bronze cover and the wall cleanouts shall have a stainless-steel cover plate.

2.2 FLOOR DRAINS, FLOOR SINKS, AND TRENCH DRAINS

- A. Refer to Floor Drain Schedule on drawings for identification, materials, and options.

1. Manufacturers: Josam, Jay R Smith, MIFAB, Wade, Watts, Zurn.
2. If an approved manufacturer other than that specified is submitted, all options specified on the drawings shall be provided on the submitted floor drain.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains (hub drain):

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

- B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

- a. NPS 2: 4-inch-minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.
- C. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 2. Body: Bronze or cast iron.
 3. Inlet: Opening in top of body.
 4. Outlet: Larger than inlet.
 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backwater valves in building drain piping as indicated on the plans and as where required by code. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 100 feet .
 4. Locate at base of each vertical soil and waste stack.
- C. Provide a cleanout at the end of the run of each horizontal pipe serving wall hung water closets. The cleanout and associated piping serving it shall rise above the elevation of the seat of the water closets.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install wall cleanouts a minimum of 12" and a maximum of 24" above finished floor.
- G. Locate all cleanouts to be as aesthetically pleasing as possible.
- H. Install exterior cleanouts in a square concrete pour, measuring a minimum of 18" square and of 4" thick. The top of concrete and the cleanout cover shall be flush with finished grade.
 1. Exception: For exterior cleanouts installed within landscaping, not including grass, the concrete pad and the cleanout housing can be omitted.
 2. Exception: For exterior cleanouts installed in sidewalks and drive areas, a separate concrete pour is not required.

- I. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless detailed otherwise by the architect.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- J. Install air-gap fittings on indirect-waste piping discharge into sanitary drainage system.
- K. Install traps on drain outlets. Omit traps on indirect wastes unless trap is indicated.
- L. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- M. Install sleeve waterproofing device on all piping sleeves through floors that do not require a fire rating.
- N. Deep seal type traps shall be used at drains receiving any type of pump discharge, drains in all mechanical and other equipment type rooms, as well as those receiving Fire Protection drainage.

3.2 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops. Duct tape is not an acceptable plug or cap.

END OF SECTION 221319

SECTION 223400 - FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following fuel-fired water heaters:
 - 1. Commercial, high-efficiency, storage, gas water heaters.
 - 2. Expansion tanks.
 - 3. Water heater accessories.
 - 4. Water heater flue and combustion air piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, furnished specialties, accessories, flue and intake material.
- B. Shop Drawings: For all flues and intakes. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Indicate dimensions, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain listed system components through one source from a single manufacturer.
- B. Certified Sizing Calculations: Manufacturer shall certify flue and intake system sizing calculations.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- D. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.
- E. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- F. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."
 - 1. All plumbing components, including but not limited to piping, valves, backflow preventers, fixtures, etc that are connected to the domestic water system which convey water to be used for human consumption shall meet the NSF-372, 'Lead-Free' requirements. Items not intended to dispense water for human consumption such as flush valves, tub fills, shower valves, or piping accessories connected to non-potable water systems, are not required to meet the 'Lead Free' requirements.
- G. Premanufactured venting systems furnished under this Section shall conform to the requirements of The National Fuel Gas Code, NFPA-54, where applicable and shall comply with and be listed to UL1738, Standard for Venting Systems for Gas-Burning Appliances, Category II, III and IV.
- H. Components coming in direct contact with products of combustion shall carry the appropriate UL or UL listing mark or label.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period(s): From date of Substantial Completion:
 - a. Commercial, Gas Water Heaters:

- 1) Storage Tank: Three years.
 - 2) Controls and Other Components: One year.
- b. Expansion tanks: One year.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers: A.O. Smith, RBI, Lochinvar, Rheem, Intellihot and Raypak.
- B. All tanks, both storage and water heater tanks, shall be furnished with the following:
 1. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 2. Jacket: Steel with enameled finish.
 3. Anode Rods: Factory installed, replaceable magnesium.
 4. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 5. Drain Valve: Corrosion-resistant metal complying with ASSE 1005, factory installed.
 6. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
- C. Tappings and connections shall be factory fabricated of materials compatible with tank. Attach tappings to tank before testing. Tappings and connections on each tank/instantaneous heater and/or boiler shall be:
 1. Residential: ASME B1.20.1 pipe thread.
 2. Commercial NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 3. Commercial NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
- D. Refer to Water Heater Schedule on the drawings for additional information on the capacity and characteristics of each heater.
- E. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
 1. Standard: ANSI Z21.10.3/CSA 4.3.
 2. Description: Manufacturer's proprietary design to provide at least 94 percent combustion efficiency at optimum operating conditions.
 3. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
 - a. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
 4. Factory-Installed Storage-Tank Appurtenances:

- a. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters.
- b. Temperature Control: Adjustable thermostat.
- c. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.

2.2 EXPANSION TANKS

- A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 1. Manufacturers:
 - a. AMTROL Inc.
 - b. Watts Regulator Co.
 - c. Wessels Company
 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread for NPS 2 and smaller, and ASME B16.5 flanged for NPS 2-1/2 and larger.
 - b. Air-Charging Valve: Factory installed.
 - c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - d. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank.
 - e. Exterior Coating: Galvanized or manufacturer's standard enamel paint.

2.3 WATER HEATER ACCESSORIES

- A. Gas Pressure Regulators: Include pressure rating, capacity, and pressure differential required between gas supply and water heater. The type of regulator shall be as recommended by the water heater manufacturer.
- B. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.
- C. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- D. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.
- E. Drain Pans: Corrosion-resistant metal or high density polyethylene plastic with raised edge. The dimensions shall not be less than 2" larger than the base of the water heater and shall include a drain outlet not less than NPS 3/4.
- F. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

- G. Water Hammer arrestors: ASSE 1010 or PDI WH 201, Size A water hammer arrester installed on booster heaters.
- H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4. Vacuum relief valves shall be installed on all systems in which the elevation of the water heater is above that of the plumbing fixtures and equipment that it serves.

2.4 WATER HEATER FLUE AND INTAKE PIPING

- A. Description: Venting material installation shall be as recommended by the manufacturer of the water heating equipment and shall utilize the following materials:
 - 1. PVC piping, UL1738
 - 2. Polypropylene
 - 3. AL29-4C double wall stainless steel venting
- B. PVC piping and fittings:
 - 1. Manufactured by IPEX – System 1738 PVC
 - 2. Solid-Wall PVC Pipe: certified to UL Standard 1738 “Venting Systems for Gas Burning Appliances, Categories II, III, and IV” in accordance with the NFPA-54 Natural Fuel Gas Code. System 1738® shall offer a full range of pipes, fittings, and termination kits sizes commonly found in venting applications for gas appliances.
 - 3. System 1738® PVC pipes, fittings and termination kit components shall be manufactured from compounds which comply with the material requirements of ASTM D 1784, having a cell classification of 12454.
 - 4. System 1738® PVC pipes, fittings and termination kit accessories are offered in sizes 2” through 4” and shall meet the OD dimension requirements of ASTM D1785.
 - 5. In accordance with UL 1738, each length of pipe shall be tagged with a label warning against the risk of carbon monoxide poisoning and fire if system is not installed as per IPEX Installation Instructions. System 1738 PVC Flue Gas Venting pipe, fittings and termination kits include identification markers as prescribed in the above applicable standard to indicate size, material designation, product application, maximum operating temperature, certification to UL 1738 standard and manufacturers name or trademark. The pipe will consist of two bold orange print lines located 180° apart and orange and black label on the fittings.
 - 6. System 1738® PVC cement and primer shall be certified to UL 1738 and meet the performance requirements of ASTM D2564. PVC cement will be auburn in color and shall only be used with System 1738® systems.
 - 7. System 1738® PVC Pipe, fittings, termination kits accessories and cement are tested and certified to standard UL 1738 by INTERTEK/ETL as a system. Only pipe and fittings supplied by IPEX USA LLC should be used in an installation. The UL 1738 standard does not permit the mixing of components from different manufacturers.
 - 8. System 1738® pipe, fittings, terminations and cement shall be third party listed to UL 1738. System 1738® engineered materials shall comply with ASTM D1784 and have a cell class of 12454 or 23447. System 1738® is certified as a system. Different Manufacturers Have Different Joint Systems and Adhesives. Do Not Mix Pipe, Fittings, or Joining Methods from Different Manufacturers.

C. Polypropylene:

1. Manufacturers: DuraVent, Inc., Polyflue
2. The vent shall be of rigid single wall, factory built type, designed for use in conjunction with Category II or IV condensing or non-condensing gas fired appliances or as specified by the heating equipment manufacturer.
3. Maximum continuous flue gas temperature shall not exceed 230°F.
4. Vent shall be listed for a minimum positive pressure rating of 6" W.C. and shall have passed at 15" W.C.
5. The vent system shall be continuous from the appliance's flue outlet to the vent termination outside the building. All outside vent components must be UV rated if exposed to the atmosphere. All system components shall be UL listed and supplied from the same manufacturer.
6. All fittings shall utilize a locking band system.
7. All cascade (common vented) systems must be approved by the manufacturer of the appliance and conform to CSA approval.
8. All system components such as vent supports, roof or wall penetrations, terminations, appliance connectors and drain fittings require to install the vent system shall be UL listed and provided by the vent manufacturer.
9. Vent layout shall be designed and installed in compliance with manufacturer's installation instructions and all applicable local codes.

D. AL29-4C venting:

1. Manufacturers: Heat-Fab, Inc., Metal-Fab, Inc.
2. Double-wall factory-built type metal vents rated for 550 deg F continuously for use on condensing appliances or pressurized venting systems serving Category II, III or IV appliances or as specified by the equipment manufacturer
3. Vent shall be constructed with an inner and outer wall, with a 1" annular insulating air space. The inner wall (vent) shall be constructed of 0.015 thick AL29-4C superferritic stainless steel.
4. Vent shall incorporate factory installed Viton gaskets. Inner and outer walls shall be connected by means of spacer clips that maintain the concentricity of the annular space and allow unobstructed differential thermal expansion of the inner and outer walls.
5. The outer wall (casing) shall be constructed of Type 430 stainless steel, 0.012" thickness.
6. All vent parts exposed to the weather shall be stainless steel.
7. Accessories: Tees, elbows, increasers, connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
 - a. Termination shall be provided in accordance with the water heater manufacturer's requirements. If a specific termination kit is provided by the unit manufacturer, use that approved termination. Otherwise, provide one of the following, in accordance with the unit manufacturer's requirements and project conditions and requirements.
 - b. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.

- c. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.
 - d. Termination: Exit cone with drain section incorporated into riser.
8. All supports, roof or wall penetrations, terminations, appliance connectors and drain fittings, required to install the vent system shall be included. Roof penetration pieces shall be UL listed and provided by the vent manufacturer.

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect water heaters, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test water heaters before shipment to minimum of one and one-half times pressure rating.
- C. All water heaters shall be from a single manufacturer.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases unless noted otherwise.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
 - 2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install all water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install gas-fired water heaters according to NFPA 54.
- D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
- E. Install gas pressure regulators on gas supplies to gas water heaters if gas pressure regulators are required to reduce gas pressure at burner. Provide a separate regulator per heater. Route vent from regulator to exterior of building. Locate the regulator per the distances from the heater as recommended by the water heater manufacturer.
- F. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- G. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

- H. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains.
- I. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet.
- J. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- K. Fill water heaters with water.
- L. Charge expansion tanks with air.
- M. Where the engineer has allowed the use of PVC piping, and PVC piping is allowed by the water heater manufacturer for the flue and intake piping, all PVC piping that is exterior to the building exposed to the elements, shall be painted with two coats of epoxy paint to match the adjacent structure to help protect the piping from the sun's UV light.

3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FLUE AND INTAKE PIPING INSTALLATION

- A. Piping material shall be that listed above subject to the water heater manufacturer's recommendations and certified for the specific gas appliance.
- B. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- C. Seal between sections vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- D. Terminate piping to the exterior per the water heater manufacturer's recommendations.
- E. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- F. Side wall and/or roof terminations shall be installed in such a manner to prevent rainwater from entering the flue and intake piping.
- G. Suspend venting independent of their appliance connections.
- H. Slope venting down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain. Provide condensate neutralizer on the piping prior to discharging to a drain.
- I. Support venting from building structure with bolts, concrete inserts, steel expansion anchors, welded studs, C-clamps, or beam clamps according to manufacturer's written instructions and

as detailed in the Division 22 Section 'Hanger and Supports for Plumbing Piping and Equipment.'

- J. If dampers or fans are installed in conjunction of the vent system, such equipment shall be supported independently from the vent system. Protect the vent system from twisting or movement due to fan torque or vibration.
- K. Clean internally, during and after installation, to remove dust and debris. Clean external surfaces.
- L. Provide temporary closures at ends of vents that are not completed or connected to equipment.
- M. Any flue and/or intake piping that is routed through a rated wall or floor shall be provided with fire-rated duct wrap with a thickness that provides a rating equal to or greater than the fire-rating of the assembly it is passing through.

3.4 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Commercial Water Heaters Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. On residential style water heaters, the contractor shall perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain instantaneous and commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 223400

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes all conventional plumbing fixtures and related components.
- B. Related Sections include the following:
 - 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For all fixtures to include in operation and maintenance manuals. Include information on the servicing and adjustment of all fixtures.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer. However, if fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- C. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

- D. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants" for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.
- E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."
 - 1. All plumbing components, including but not limited to piping, valves, backflow preventers, fixtures, etc that are connected to the domestic water system which convey water to be used for human consumption shall meet the NSF-372, 'Lead-Free' requirements. Items not intended to dispense water for human consumption such as flush valves, tub fills, shower valves, or piping accessories connected to non-potable water systems, are not required to meet the 'Lead Free' requirements.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 2. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 3. Vitreous-China Fixtures: ASME A112.19.2M.
 - 4. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 5. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. Pipe Threads: ASME B1.20.1.
 - 9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 10. Supply Fittings: ASME A112.18.1.
 - 11. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for bathtub and shower faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - 3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hand-Held Showers: ASSE 1014.
 - 6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.

7. Hose-Coupling Threads: ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F 444.
9. Pipe Threads: ASME B1.20.1.
10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Brass Waste Fittings: ASME A112.18.2.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Floor Drains: ASME A112.6.3.
2. Pipe Threads: ASME B1.20.1.
3. Plastic Toilet Seats: ANSI Z124.5.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Commercial Applications: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIXTURES

A. All fixtures basis of design is listed on the drawings. The following manufacturers are approved subject to compliance with the requirements listed on the drawings.

1. Lavatory faucets: American Standard, Chicago Faucets, Kohler, Moen, Sloan, Symmons, Zurn.
2. Bathtub/shower faucets: Delta, Kohler, Moen, Powers, Symmons, Zurn.
3. Sink faucets: American Standard, Chicago Faucets, Delta, Elkay, Grohe, Kohler, Moen, Sloan, Zurn, Sloan, T&S Brass.
4. Flush valves: Kohler, Sloan, Zurn, Hydrotek, American Standard.
5. Toilet seats: American Standard, Bemis, Centoco, Church, Kohler, Olsonite.
6. Protective shielding guards: McGuire, Plumberex, TRUEBRO, Zurn, Dearborn, Oatey.
7. Fixture supports: Josam, MIFAB, Jay R Smith, Watts, Zurn.
8. Water closets: American Standard, Kohler, Sloan, TOTO USA, Zurn.
9. Urinals: American Standard, Kohler, Sloan, TOTO USA, Zurn.
10. Bidets: American Standard, Kohler.
11. Lavatories: American Standard, Kohler, Sloan, TOTO USA.
12. Commercial sinks: Elkay, Just, Acorn.
13. Shampoo bowl: Belvedere USA.
14. Wash fountains: Acorn, Bradley, Sloan.
15. Bathtubs: Jacuzzi, Kohler, American Standard.
16. Individual showers: Aqua Glass, Florestone, LASCO, Swan, Aqua Bath.
17. Group showers: Acorn, Bradley.
18. Whirlpool bathtubs: American Standard, Kohler, American Whirlpool, Jacuzzi.
19. Kitchen sinks: Kohler, American Standard, Elkay, Just.
20. Bar sinks: Kohler, American Standard, Elkay, Just.
21. Service sinks: American Standard, Kohler, Fiat, Stern Williams.
22. Service basins: Acorn, Fiat, Stern-Williams.
23. Laundry trays: Fiat, Zurn.
24. Shower receptors: Florestone, LASCO, American Standard, Jacuzzi, Kohler, Acorn.
25. Disposers: In-Sink-Erator; KitchenAid.
26. Hot water dispensers: In-Sink-Erator, Elkay, KitchenAid.
27. Drinking fountains & water coolers: Filtrine, Halsey Taylor, Haws, Oasis, Sunroc, Elkay.
28. Clinical sinks: American Standard, Kohler, Zurn.
29. Fixture stops, tailpieces, traps, etc: Zurn, JR Smith, McGuire, Brasscraft, Josam, Sioux Chief

B. Unless specifically specified otherwise on the drawings, provide fixtures with the following:

1. Sinks and Lavatories
 - a. 17 gauge brass polished chrome tailpiece, trap, and escutcheon.
 - b. Brass polished chrome quarter turn angle stops.
 - c. Braided stainless steel supply hoses.
2. Tank type water closet:
 - a. Brass polished chrome quarter turn angle stops.
 - b. Braided stainless steel supply hose.
3. Bathtub/Shower valves:
 - a. Screwdriver stops

4. Flush valves
 - a. Solid ring pipe support
5. Water Closet Seats
 - a. All public toilet seats shall be provided less lid with an open front seat.
 - b. Seats within residential/dwelling unit type spaces (residences, apartments, condos, and hotel rooms) shall be provided with closed front seat with a lid.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install wall-mounting fixtures with tubular waste piping attached to supports.
- D. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- E. Install all fixtures level and plumb according to roughing-in drawings.
- F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- I. Install flush valves and trip levers for accessible water closets and urinals with handle mounted on wide side of compartment.
- J. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- K. Install trap-seal liquid in dry urinals.
- L. Install faucet-spout and flow-control fittings with specified flow rates and patterns.
- M. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- N. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- O. Provide separate hot water angle stop under residential kitchen sinks where located adjacent to residential type dishwashers. Connect dishwasher waste to sink waste.
- P. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
- Q. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding

fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

- R. Set bathtubs shower receptors and service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- S. Unless otherwise noted in Division 7, seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
- T. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.2 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.3 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets and flush valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Adjust drinking fountains for proper temperature setting and the flow regulators for proper flow and stream height.
- E. Install fresh batteries in sensor-operated mechanisms.
- F. Adjust sensor angle and range on sensor-operated faucets and flush valves for proper operation.

3.4 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.5 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 227000 - FUEL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.

1.3 PERFORMANCE REQUIREMENTS

- A. The system is designed for natural gas. All system components shall be listed and rated for the design fuel gas.
- B. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 125 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 125 psig minimum unless otherwise indicated.
- C. Refer to the drawings for system pressures within the building(s).
- D. Delegated Design: The contractor shall be responsible for the design of the routing, sizing, and pipe material of the venting from all regulators not equipped with a vent limiting device. All venting all be extended to the exterior of the building, terminating in a location and method as required by the local code and AHJ. All vents shall be designed and installed per the requirements of the regulator manufacturer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For items including motorized gas valves, pressure regulators, and sub-meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Black Steel Pipe: ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B.
 - 1. Manufacturers:
 - a. American Piping Products
 - b. United States Steel Corporation
 - c. Wheatland Tube
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 3. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 5. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless-steel underground.
 - 6. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.2 PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

- ### A. Joint Compound and Tape: Suitable for natural gas.
- ### B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves:

1. NPS 2 and Smaller: Comply with ASME B16.33 with threaded ends complying with ASME B1.20.1.
2. NPS 2-1/2 and Larger: Comply with ASME B16.38 with flanged ends complying with ASME B16.5 for steel flanges.
3. CWP Rating: 125 psig unless noted otherwise.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches and larger shall have initials "WOG" permanently marked on valve body.

B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Nibco Valve.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.

C. Cast-Iron Lubricated Plug Valves: MSS SP78, ASME B16.33, ASME B16.38.

1. Manufacturers:
 - a. Homestead Valve Co.
2. Body, plug and bonnet: Cast iron, complying with ASTM A126 Class B.
3. Flanges: Complying with ASME B16.1. Class 125 cast iron flanges will be flat faced.
4. Threaded Ends: Complying with ANSI B-1.20.1.
5. Stem seal: PTFE
6. Lubricant: Compatible with natural gas.
7. Operator: Square head with tamperproof feature where indicated.
8. Pressure Class: ½" through 12": 200 psig.

14" through 24": 150 psig.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.
5. Provide lock-up style regulator at boiler and boiler type water heater connections as required by the manufacturer. Additionally, lock-up style regulators shall be used at all locations that reduce the pressure from greater than 2psi to 14" w.c. or less.

B. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers:
 - a. Eaton Corporation; Controls Div.
 - b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - c. Maxitrol Company.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.

4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure shall be as shown on the drawings.

2.6 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and all state and local codes for installation and purging of gas piping.
- B. Verify final equipment locations for roughing-in. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- C. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- D. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- E. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view. For piping within solid partitions/walls and piping installed under the building, the piping shall be located in containment conduit constructed of steel pipe with welded joints or Schedule 40 solid wall PVC pipe with solvent weld joints. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 1. Above Accessible Ceilings: gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 3. Prohibited Locations:

- a. Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install gas piping in solid walls or partitions.
- F. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- G. Connect branch piping from top or side of horizontal piping.
- H. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- I. Do not use gas piping as grounding electrode.
- J. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- K. Install pressure gage downstream from each line regulator.
- L. Cable release valves shall be installed at every kitchen hood from the fire suppression system. The valves are typically provided with the hood. Should they not be provided, the contractor is responsible for both providing and installing these valves to make the system fully operational.
- M. Each kitchen hood shall be provided with heat sensors to ensure the hood is operating during any cooking beneath it. Should heat sensors not be provided with the hood, the contractor shall provide a solenoid valve on the gas piping upstream from the kitchen equipment under each hood. The solenoid valve shall be wired to the hood control, closing the solenoid valve when the hood is not in operation.
- N. Within each commercial kitchen, paint all exposed gas piping yellow (unless noted otherwise by the architect) to include that behind all cooklines, under hoods, etc to allow for ease in future cleaning.
- O. At each boiler/water heater room having equipment with an input of 400,000 btuh or greater, provide a motorized or solenoid normally closed 2-way shutoff valve rated for the full flow of the equipment in the room. The valve shall be wired to emergency push button stops located immediately inside each door serving the space as required by ASME CSD-1. Provide a dedicated UPS inverter (uninterrupted power supply) serving the electrical connection on this system.
- P. Connect gas sub-meters to allow for remote monitoring/recording and/or billing.

3.2 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.3 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M and AWS D10.18/D10.18M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for fuel-gas service. Install gasket concentrically positioned.

3.4 CONNECTIONS

- A. Connect to gas utility per their procedures and requirements.
- B. Install gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.5 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for piping and valve identification. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.6 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction or per the method below if the AHJ has no specific requirements.
 1. Before actuation of the gas system the system shall be flushed with dry nitrogen to ensure a clean system free of oil and construction debris.

2. Gas piping shall be tested with dry nitrogen at 50 psi above the operating pressure for 2 hours. A soap test of each joint shall be done to detect leaks during the 2-hour period. No loss of pressure during test period.
 3. Carbon Steel Press-Connect Fitting Joints: After fittings have been installed a "two step test" shall be followed. Utilizing air or dry nitrogen, pressurize the system between .5 psi and 45 psi. Check the pressure gauge for pressure loss. If the system does not hold pressure, walk the system and check for un-pressed fittings. Should you identify an un-pressed fitting/s ensure the pipe is fully inserted into the fitting and properly marked prior to pressing the joint. After appropriate repairs have been made, test the system per local code, or specification requirements, not to exceed 200 psig.
- B. Prepare test and inspection reports.

3.7 INDOOR PIPING SCHEDULE

- A. Aboveground piping shall be one of the following:
1. Black steel pipe with malleable-iron fittings and threaded joints.
 2. Black steel pipe with wrought-steel fittings and welded joints.
- B. Containment conduit vent piping shall be one of the following:
1. Black steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping. Coating shall be a flexible polymer film with a coal tar and synthetic elastomeric coating of 36 mil thickness and dielectric strength exceeding 12 KV, equal to TapeCoat CT.
 2. PVC piping and fittings with solvent weld joints.

3.8 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves in pipe sizes NPS 2 and smaller shall be the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
- B. Valves in pipe sizes NPS 2-1/2 and larger shall be the following:
1. Cast-iron, lubricated plug valve.

END OF SECTION 227000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Grout.
 - 2. Flashing materials.
 - 3. Access panels
 - 4. Equipment installation requirements common to equipment sections.
 - 5. Painting and finishing.
 - 6. Concrete bases.
 - 7. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SCOPE

- A. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work may not be specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

- B. It is the intent that these Specifications and associated Drawings establish minimum requirements for products and equipment with the intent to provide HVAC systems finished, tested and ready for operation. Incidental detail that is not shown or specified, but necessary for proper installation and operation shall be included in the work and in these Contractor's estimates, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each pipe, duct and piece of equipment to minimize conflicts with other trades.
- C. This project may be phased, as defined by the Owner. This may necessitate the provision of temporary valving and capping of existing utilities or HVAC systems. All associated appurtenances with the utilities shall be provided as part of this project in the appropriate phase coordinated with Owner's phasing requirements.
- D. It is the requirement of these Contract Documents to have the contractors provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation the Contractor shall include the specific components or subsystems with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

1.5 MODIFICATIONS IN LAYOUT

- A. Drawings are intended to outline the scope of work required and are not intended to be installation drawings. Drawings are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component nor do they show the exact routing and locations needed to coordinate with structure and other trades and to meet Architectural requirements. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.
- B. Unless specifically stated to the contrary, no measurement of a drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the drawings are subject to measurements of adjacent and previously completed work. Measurements shall be performed prior to the actual installation of equipment.
- C. Prior to installation of visible material and equipment (including access panels) in finished spaces, review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.
- D. Check Contract Documents, as well as, Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Divisions 21 through 28 will be installed.
- E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades. Systems shall be run parallel with or perpendicular to major architectural and structural building elements.
- F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

1.6 COORDINATION

- A. Refer to Division 23 Section "BIM Coordination Drawings" for complete requirements.
- B. Coordinate arrangement, mounting, and support of piping and equipment:
 - 1. To maintain maximum headroom; all piping, duct, conduit and associated components to be as tight as possible to underside of structure to provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 2. To allow right of way for piping installed at required slope.
 - 3. To be clear of obstructions and of the working and access space of other equipment.
- C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- D. Coordinate location of access panels and doors for HVAC items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

1.7 RECORD DOCUMENTS

- A. Record Drawings are specified in Division 01 Section "Project Record Documents."
- B. The Contractor shall keep a detailed up-to-date record, of the manner and location in which installations are actually made, indexing pipe, duct, and piece of equipment. Record documents are to reflect all changes in work including change orders, field directives, addenda from bid set of Contract Documents, request for information responses, etc. Upon completion of the project, the contractor shall modify the project electronic drawing and specification files to incorporate this information. Modified documents shall be turned over to the Owner in both electronic and hard paper copy formats. Record drawings shall also include:
 - 1. Locations of buried piping or similar items. Include buried depth.
 - 2. Field changes of dimension or detail.
 - 3. Changes made by field order or change order.
 - 4. Details not on original contract drawings.

1.8 MAINTENANCE MANUALS AND OPERATING INSTRUCTIONS

- A. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in a coordinated manual. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment.
- B. The manuals shall include the following and shall have an index of contents and tabs for each Specification Section and each piece of equipment specified in that Section and be provided in the order listed below, per Specification Section.
 - 1. Copies of all approved submittals/shop drawings.
 - 2. Manufacturer's operating and maintenance instructions and parts lists of all items or equipment. Where manufacturer's data includes several types or models, the applicable type or model shall be clearly designated.

3. Startup and shutdown procedures.
 4. Flow diagrams.
 5. Test records.
 6. Wiring diagrams.
 7. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment.
 8. Owner's written acknowledgement of satisfactory completion of instruction period.
- C. Furnish three copies of manuals to Architect for approval and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.
- D. Operating instructions: Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct Owner's operating personnel in any or all parts of all systems. Factory-trained personnel shall perform instructions.

1.9 SUBMITTAL PROCEDURE AND FORMAT

- A. This Article supplements Division 1.
- B. Submittal Cover Sheet
1. Submittal data for each product shall include a copy of the following cover sheet completely filled out. Incomplete or incorrect cover sheet submittal shall constitute reason for rejection.
Material submittals shall be organized by specification section. All items requiring a submittal per each specification section shall be combined into a single submittal. Provide each section/item within that submittal with its own cover sheet labeled and tagged to match the drawings.
- C. Shop Drawings showing layouts of systems shall contain sufficient plans, elevations, sections, details and schematics to describe work clearly. They shall be 1/4 inches = 1 foot 0 inch scale unless specified otherwise.
- D. Shop drawings and submittals showing manufacturer's product data shall contain detailed dimensional drawings, accurate and complete description of materials of construction, manufacturer's published performance characteristics and capacity ratings (performance data, alone, is not acceptable), electrical requirements and wiring diagrams. Drawings shall clearly indicate location (terminal block or wire number), voltage and function for all field terminations, and other information necessary to demonstrate compliance with all requirements of Contract Documents.
- E. Provide shop drawing submittals showing details of piping connections to ALL equipment. If connection details are not submitted and connections are found to be installed incorrectly in the field, this contractor shall reinstall them within the original contract price.
- F. Shop drawings for different systems and equipment shall be bound separately by specification section as indicated above and not bound by manufacturer. Each separate submittal shall have its own transmittal and cover letter. Submittals which contain different specification section systems bound together may be returned un-reviewed for re-submittal.

1.10 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for HVAC Equipment: Equipment of different electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at the contractor's expense. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- C. All electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Skid-mounted or packaged assemblies shall be listed and labeled as an assembly, not just the individual components.
- D. Fire-Resistance Ratings: For piping, conduit and wiring penetrations, provide penetration firestopping devices tested for fire resistance per ASTM E 814 by a testing agency acceptable to authorities having jurisdiction. Indicate design designations from UL's "Fire Resistance Directory."
- E. Acceptable Manufacturers
 - 1. The Engineer's design for each product is based on the manufacturer listed in the schedule or shown on the drawings. In Part 2 of some technical specifications, other manufacturers are listed as being acceptable. The listing of a manufacturer as acceptable does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. These are acceptable only if, as a minimum, they:
 - a. Meet all performance criteria listed in the schedules and outlined in the specification.
 - b. Have identical operating characteristics to those called for in the specification. For example, a two-stroke diesel generator will not be acceptable if a four-stroke model is specified.
 - c. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Engineer has determined that the manufacturer's products will fit within the available space - this determination is solely the responsibility of the contractor.
 - d. Products must adhere to all architectural considerations including but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers, lighting and plumbing fixtures - being the same size and of the same physical appearance as scheduled or specified products.
 - e. All equipment shall be labeled or listed by the National Board of Underwriters Laboratories (U.L.) where such labeling or listing exists for such material.

1.11 TEMPORARY SERVICES/CONTINUITY OF UTILITY SERVICES

- A. In the absence of specific requirements in Division 1, comply with the following procedures for shut-downs.
- B. Provide temporary services where project construction schedule requires extended shut downs of existing equipment and/or systems. Temporary services include the necessary equipment and/or systems to maintain continuity of services. Extended shut downs are interruptions of existing services for a period of time longer than that acceptable to the Owner.
- C. Contractor shall coordinate any shutdowns of existing systems as follows:
 - 1. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days is required.
 - 2. Minimize timeline of shutdowns of any system.
 - 3. Provide temporary services where required and perform shutdowns and tie-ins at a time convenient to Owner.
 - 4. Contractor shall be responsible for completing and filing the Owner's shutdown notice questionnaire.
 - 5. Perform required survey and inspection work required by the notice for shutdown.
 - 6. All life safety systems shall be returned to service at the end of each work day, when work is being performed on the systems. It is the responsibility of the Contractor to provide all associated appurtenances necessary to ensure that the systems are in proper working condition at all times.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment/materials from damage during shipping, storage, handling and installation. Delivery equipment/materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- B. The Contractor shall provide for enclosed storage, when equipment/materials are stored on-site and prior to building "dry-in", to prevent any damage resulting from inclement weather or construction traffic. Specialties shall not be stored outdoors.
- C. Equipment/materials, stored or installed, found to be damaged shall be replaced with new by the Contractor, to the satisfaction of the Owner and at no additional expense. Do not store equipment with PVC material with exposure to direct sunlight.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection. This is applicable for all Division 23 sections.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.3 FLASHING MATERIALS

- A. All piping, conduit and equipment supports through roofs shall be flashed. Flashing materials and methods shall be in accordance to the roof manufacturer's and Division 07 requirements.

2.4 CEILING ACCESS AND ACCESS PANELS

- A. Access panels are generally not shown on the drawings, but they are required to be provided by the Division 1 Contractor. Divisions 23 contractor shall closely coordinate all required access panels with the Division 1 Contractor.
- B. Provide proper access to materials and equipment that require inspection, replacement, repair or service, and coordinate their delivery with the installing Trade. If proper access cannot be provided, confer with Architect as to best method of approach for minimizing effect of reduced access which may result.
- C. The maximum distance from the ceiling line to serviceable equipment (i.e., air terminal boxes, valve handles, volume damper handles, etc.) shall be 24 inches unobstructed, unless otherwise noted on the drawings.
- D. Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment and deliver to a representative of the installing Trade. Furnish and install distinctively colored buttons (color as selected by Architect) in finished ceiling to identify all access panels.
- E. Ceilings consisting of lay-in or removable splined tiles do not require access panels. Fire, control dampers, valves and equipment located above ceiling shall have location marked with color-coded identification screws attached to the ceiling "grid." Location shall be noted on record drawings.
- F. Furnish access panels for installation under other Sections for valves or other items installed under this Division that require access and are concealed in floor, wall, furred space or above ceiling. Coordinate selection with other Sections supplying similar access panels. Color of panel shall be selected by the Architect.
- G. Access panels shall have same fire rating classification as surface penetrated. Rated access panels must have U.L. Label.
- H. Panels shall be at least 12 inches x 12 inches; access panels at equipment (VAV boxes, fan boxes and others) shall be at least 18 inches x 18 inches.

PART 3 - EXECUTION

3.1 PRE-BID SITE VISIT

- A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this division. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.
- B. Contractor shall visit job site to familiarize himself with the specific location of the new equipment installations in existing areas, to ensure there is adequate access for the installation of equipment. All entries, pathways, corridors, stairwells, etc., that may be used to install equipment shall be investigated. All existing conditions and potential obstructions that may impede access and installation shall be addressed prior to equipment purchasing/ordering.
- C. The documentation of existing conditions was derived from As-Built documents and are in part unverified. Actual existing conditions shall be verified prior to commencement of work.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. All equipment shall be installed per the manufacturer's installation requirements.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment to allow right of way for piping installed at required slope.
- F. If it is determined that in order to install equipment in an existing space, disassembling of the equipment will be required, the Architect shall be notified immediately, prior to ordering equipment. Confirmation that equipment factory warranties will not be voided shall be confirmed in writing. Arrangements for factory-authorized assembly at the job site shall then be made and be considered part of the construction cost

3.3 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

- A. Provide raised concrete pads for all floor mounted equipment.

- B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions at Project. Where specific requirements are not specified in Division 3 or detailed on the Drawings, comply with the following at a minimum:
1. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated. Bases for air handling units shall be minimum 6 inches high but may be required to be taller depending on condensate trap depth..
 2. Edges of concrete bases shall have a minimum 1-1/2 inch chamfer.
 3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 6. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
 7. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 8. Use 3000-psi, 28-day compressive-strength concrete with wire-mesh reinforcement.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.
- D. Fireproofing:
1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, prior to start of spray fiber work.
 2. Piping and other items which would interfere with proper application of fireproofing shall be installed after completion of spray fiber work.
 3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by trade responsible for damage and shall not constitute grounds for extra cost to Owner.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.7 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.8 WELDING

- A. Weld only by approved acetylene or electric welding processes and welders shall hold certificate from approved insurance company.
- B. Conduct test to demonstrate suitability of procedures to be used in making welds, which conform to specified requirements.
- C. Specification for welding procedure shall meet requirements of Welding Qualifications, Section IX, ASME Boiler and Pressure Vessel Code and ANSI B31.1.
- D. Align components. No strain shall be placed on weld during welding. No part of pipe shall be offset more than 20% of thickness. Set flanges and branches properly.
- E. Welder and Brazing Qualification:
 - 1. Test welders to demonstrate ability to make acceptable welds. Tests conducted for qualification of welder for work under one Division or Section shall not necessarily qualify welder for work under another Division or Section.
 - 2. Tests shall be as prescribed for welder qualification in Section IX of the ASME code.
 - 3. Records of such tests shall be as follows: Each welder shall be assigned an identifying number, letter or symbol. Identifying mark shall be stamped adjacent to welds made by this welder. Identification shall be at top of horizontal piping and at front of vertical piping.
 - 4. Maintain record of welders employed, showing dates and results of tests and identifying mark assigned to each welder. Certify records and make them accessible to Owner's project representative and/or project manager. Before completion of project, one copy of records shall be turned over to Owner.
 - 5. No qualification shall be older than three years when welder commences work on this project. If welder has not welded in required welding process for a period of six months, he shall be re-certified.
- F. Welding Tests
 - 1. As designated by Architect, remove welds for destructive testing or for testing by non-destructive means. Tests shall be as determined by Architect.
 - 2. If, in Architect's opinion, welds so tested do not meet requirements of Sections VIII and IX of ASME, then the Contractor shall pay for the costs of the tests. Remove welds welded by that welder, at no cost to the Owner. Rewelding shall be performed by

qualified welder other than welder whose welds did not pass test. Welders whose welds were defective shall not be employed on site for remainder of project.

3. Welding of stanchions, brackets, anchors and other welding not performed on pipe joints shall be in accordance with requirements of AWS specifications and requirements.

3.9 INSTALLATION ONLY ITEMS:

- A. Where this contractor is required to install items which he does not purchase, he shall coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. This contractor shall be responsible for:
 1. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
 2. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
- B. This Contractor shall carefully examine such items upon delivery. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of work of this Contractor will be considered only if presented in writing within one week of their date of delivery. Unless such claims have been submitted, this Contractor shall be fully responsible for the complete reconditioning or replacement of the damaged items.

3.10 PIPING SYSTEMS – COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping to permit valve servicing.
- E. Install escutcheons for exposed piping penetrations of walls, ceilings and floors.
- F. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe, conduit and wiring penetrations. Seal penetrations with fire- and smoke-stop materials. Refer to Division 07 for firestopping and fill materials.
- G. Waterproof Penetrations: Maintain integrity of waterproof roof, wall and floor penetrations for pipe, conduit and equipment support penetrations. Seal penetrations with waterproof materials with clamps, sleeves, flashings, pipe boots and/or pipe curb assemblies as detailed or specified. Refer to Division 07 for waterproofing methods and materials when not specified in this section.

- H. If, after project is in operation, any piping systems, coils or other apparatus are stratified or air bound (by vacuum or pressure), they shall be re-piped with new approved and necessary fittings, air vents, or vacuum breakers at no extra cost to the Owner. If connections are concealed in furring, floors, or ceilings, this trade shall bear all expenses of cutting, patching and refinishing construction and finish, leaving same in as good condition as before it was disturbed.

3.11 CLEANING

- A. Cleaning shall be performed prior to system start-up.
- B. Ductwork

1. Ducts shall be thoroughly cleaned so that no dirt or dust will be discharged from diffusers, registers or grilles, when system is operated.
2. Clean all ductwork both internally and externally to remove all dirt, plaster dust or other foreign materials. When external surfaces of ductwork are rusted, clean and restore surfaces to original condition.
3. Provide temporary connections required for cleaning. Provide cheesecloth for openings during cleaning.
4. Replace filters prior to final inspection and testing.

- C. Piping

1. General:
 - a. After all piping systems have been pressure tested and approved for tightness, flush and clean piping as specified and as required by codes.
 - b. Furnish pipe cleaning chemicals, chemical feed equipment, materials and labor necessary to flush and clean piping.
 - c. Permanently install necessary chemical injection fittings complete with stop valves.
 - d. Monitor the water temperatures and prevent the heat generated by the pump circulating the water from causing the water temperature to exceed the temperature ratings of the pipe, pumps, and other components of the piping system during the flushing and cleaning process.
 - e. Contractor to provide a portable temporary pumping apparatus for the purpose of flushing and cleaning. Pump shall be adequate to provide the required velocities necessary for the process.
 - f. When external surfaces of piping are rusted, clean and restore surfaces to original condition.
2. Flushing:
 - a. All water side equipment control valves, strainers, etc., shall be bypassed prior to and during the flushing process.
 - b. Flush all water, steam and condensate systems clear of all dirt and foreign matter with all pumps bypassed. All flushing to be at a circulation rate of 6 f.p.s.

- c. Maintain continuous blowdown and make-up, as required during flushing operation.
 - d. Once flushing is complete and prior to cleaning, all final connections to equipment shall be performed.
 - e. Water samples taken from the system during flushing shall determine when the system is ready for the cleaning process.
3. Cleaning:
- a. Clean all pipeline strainer baskets and return to original condition or replace with new baskets prior to the pipe cleaning process.
 - b. The cleaning chemicals shall be designed to remove deposition from construction, such as pipe dope, oils, loose mill scale, and other extraneous silt and mud. The products shall inhibit corrosion of the various metals in the system and shall be safe to handle and use with normal chemical safety equipment, i.e., gloves and safety glasses. Effectiveness of the product shall be such that the water need only be at ambient temperatures.
 - c. During the cleaning procedure, remove strainers, automatic air vents, flow regulators and any other item that would be affected by the clean and flush procedure. All control valves and coils should be set up for wide open, full flow.
 - d. After initial flushing of a system, use portable pumping apparatus for a continuous 24 hour circulation of a cold water detergent equal to Nalco 2567 cleaner.
 - e. After circulating for the prescribed time, systems shall then be drained and flushed until the total alkalinity or conductivity of the rinse water is not more than 20% higher than the readings for the make-up water. Refill with clean water, and treat with scale and corrosion inhibitor. Contractor shall furnish the chemicals, supervise the cleaning, test the water after flushing, and shall provide a report that certifies successful cleaning and flushing of the piping.

3.12 COMMISSIONING

- A. The Commissioning Authority will be Owner furnished and under direct contract with the Owner. That is, the General Contractor and this subcontractor's bid price shall not include the services of the Commissioning Authority but shall include costs for coordination testing, Contractor commissioning, etc.

END OF SECTION 230500

SECTION 230510 – HVAC DEMOLITION AND ALTERATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Disconnection of mechanical equipment in selected portions of building or structure.
 - 2. Demolition and removal of selected mechanical components.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Division 01 Section "Cutting and Patching."
 - 2. Division 02 Section "Selective Structure Demolition" for sequencing and scheduling procedures and requirements for demolition activities.

1.3 JOB CONDITIONS

- A. Perform all demolition as needed to accomplish new work.
- B. Do not rely solely on mechanical drawings to determine extent of general construction demolition. Refer to architectural demolition plans for the exact extent of general construction demolition required by this contract.
- C. This Contractor is responsible for all charges, fees etc. incurred as a result of the mechanical portion of the demolition.
- D. Prior to demolition or alteration of structures, the following shall be accomplished:
 - 1. Review available record documents of the existing construction. Owner does not guarantee that existing conditions are same as those indicated in record documents.
 - 2. Coordinate sequencing with Owner and other Contractors.
 - 3. Coordinate means to separate construction zones from non-renovated zones to prevent the spread of dust, fumes and debris.
 - 4. Coordinate means to provide exhaust and makeup air to maintain the construction zone at an adequate negative pressure to contain all construction dust and fumes.
 - 5. Except as noted otherwise, remove from the premises, all materials and equipment removed in the demolition work.
 - 6. Equipment noted to be removed and turned over to the Owner, shall be delivered to the Owner at a place and time he so designates.

7. Where the materials are to be turned over to the Owner or reused and installed by the Contractor, it shall be the Contractor's responsibility to maintain the condition of the materials and equipment equal to that existing before work began. Damaged materials or equipment shall be repaired or replaced at no additional cost to the Owner.
8. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore existing facilities to their pre-demolition condition, at no additional cost to Owner.
9. Salvage equipment scheduled for reuse in new work or scheduled to be delivered to Owner's storage facility.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Existing mechanical equipment in conflict with new construction shall be removed and/or relocated as indicated on the drawings, as directed or needed. This Contractor shall remove all mechanical equipment released from service as a result of construction, and no equipment removed shall be reused, except as specifically directed on the drawings or elsewhere herein. All mechanical components shall be stored on site for Owner assessment. Any components not retained by the Owner shall be removed by the contractor. Properly dispose or remove from site any items not retained by Owner.
- B. Any existing services or equipment not shown on the drawings and which are logically expected to be continued in service and which may be interrupted or disturbed during construction, shall be reconnected in an approved manner. Provide temporary ducts, pipes, controls, etc., as needed to prevent interruption of service to occupied areas caused by demolition operations. In addition, any ductwork, piping or equipment which may require relocation or rerouting as a result of construction, shall be considered a part of the work of this section and shall be done by this Contractor with no additional compensation, provided that the referenced relocation is discernable from the pre-bid review of the site, and associated documents.
- C. This Contractor shall remove all ductwork, piping, straps, and existing equipment, being discontinued or removed due to construction. Abandoned or removed services shall be disconnected and capped at the perimeter of the project or as required elsewhere in the documents.
- D. The existing building is to remain in operation during construction. This Contractor shall coordinate all work including shutdowns for removing or adding equipment that will interfere with the present operation of the facility with the Owner and Construction Manager.
- E. All existing equipment that is to remain shall be cleaned inside and out. Clean all pipeline strainer baskets and return to original condition or replace with new baskets. All dirt, plaster dust and other foreign matter shall be blown and/or cleaned from coils, terminal devices, diffusers, registers, and grilles. Touch up paint equipment in exposed areas.

- F. Ductwork systems indicated to remain shall be wiped or vacuumed clean both internally and externally to remove all dirt, plaster dust or other foreign materials.
- G. Existing ductwork in remodeled area that is not being removed shall be sealed as necessary to comply with SMACNA standards and requirements of ductwork section of the specifications.
- H. All coring that is required for mechanical work shall be done by this Contractor.
- I. All cutting and patching required for mechanical work shall be by this Contractor.
- J. This Contractor shall provide required additional support for existing ductwork and piping in remodeled area that is not being removed and is not properly supported.
- K. When existing ductwork, piping, or related equipment in remodeled areas prevents the installation of other work, remove and reinstall existing materials, making necessary modifications and transitions to coordinate with other trades.
- L. Maintain construction zone at adequate negative pressure by providing exhaust by mechanical means until all work which creates dust or fumes is completed.
- M. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed unless noted otherwise.
 - 1. Components to Be Removed: Remove associated HVAC system components including all associated piping, ductwork, supports, grilles, power and controls.
 - 2. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 3. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 4. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 5. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 6. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 7. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 8. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- N. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
- O. Contractor shall verify that all equipment to be re-used is in satisfactory and functional condition. Notify the architect and engineer of any deficiencies before removing the equipment.
- P. The contractor shall perform testing of any air or hydronic system that is to be modified to identify existing flows and pressures. These values shall be used to return flows in sections to remain to pre-renovation values after the renovation.

3.2 CLEANING AND REPAIR

- A. Clean existing materials and equipment which remain or are to be reused. Report damage or defects to Architect

3.3 TESTING

- A. Existing equipment shall be tested before demolition begins to determine existing operating conditions and capacities. Upon completion of all new work, the existing equipment shall be rebalanced to serve the new areas and maintain existing capacities in existing areas.

END OF SECTION 230510

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors or electronically commutated (ECM or EC) motor for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
- B. Related Sections Include:
 - 1. Division 26 Section "Enclosed Switches and Circuit Breakers".
 - 2. Division 26 Section "Enclosed Controllers"
 - 3. Division 26 Section "Variable-Frequency Motor Controllers".

1.3 DEFINITIONS

- A. ODP: Open Drip Proof
- B. TEFC: Totally Enclosed Fan Cooled
- C. TEAO: Totally Enclosed Air Over
- D. EC Motor: electronically commutated motor
- E. VFD: Variable frequency drive (motor controller)
- F. Service Factor: A multiplier to motor's nameplate rated power as an indicator of overload rating.

1.4 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.
- B. Provide all motors, power transformers, control power transformers and all electrically powered or electrically controlled equipment.

- C. Drawings and/or specifications show number and horsepower rating of all motors, together with their actuating devices. Should any change in size, horsepower rating or means of control be made to any motor or other electrical equipment after the contracts are awarded, Division 23 Contractor is to immediately notify General Contractor of change. Any additional costs due to these changes shall be the responsibility of Division 23 Contractor.
- D. Division 26 Contractor will provide power wiring to starter, disconnect and motor and connect all equipment complete and ready to operate. Division 23 Contractor shall provide all control wiring line and low voltage, including temperature control wiring and associated conduit for all control wiring.
- E. Wire all equipment associated with this contract, including interlock wiring, except wiring which is scheduled to be done by others.
- F. Provide wiring diagrams to Division 26 Contractor for all apparatus indicating external connection and internal controls.

1.5 STARTERS, VFD's, AND DISCONNECTS BY DIVISION 23

- A. All starters, disconnects, VFDs, relays, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment shall be furnished by Division 23 contractor, except as specifically noted elsewhere in these specifications. Where starters and disconnects are furnished by Division 23 Contractor, they shall be installed by Division 26 Contractor, coordinated with Division 26 Contractor, connected by Division 26 Contractor, and furnished in accordance with Division 26 Sections of the specifications.
- B. Coordinate minimum AIC ratings with Division 26 drawings for Division 23 supplied disconnects, starters and variable frequency drives.
 - 1. Refer to electrical drawings Equipment Connection Schedules for disconnect size, fuse/non fused, requirements.
 - a. Disconnect amperage and fuse size (if fused disconnect) shall match approved equipment's nameplate requirements.
 - 2. Starter and VFD AIC ratings shall not be less than the upstream panel rating unless noted otherwise.
- C. Furnish starters, disconnects, over current protection and variable frequency drives in accordance with Division 26 Specifications.
 - 1. Refer to electrical "Equipment Connection Schedules" on electrical plans for additional requirements.
- D. AIC Ratings:
 - 1. All starters, disconnects, and variable frequency drives (VFDs) shall comply with minimum amps interrupting current (AIC) rating as identified on Division 26 drawings and specifications. Where furnished equipment does not meet these minimum ratings requirements by itself, then a U.L. series rating can be used by providing a U.L. recognized fuse or circuit breaker located upstream of starter or VFD in accordance with

U.L. distance limitations. Division 23 Contractor is responsible for providing any additional fusing or circuit breakers to meet the minimum AIC requirements.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or individual specification sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard duty, high torque, or any other special type as required by the manufacturer's recommendations.
 - 1. Furnish ODP Motors for indoor non-hazardous environments.
 - 2. Furnish motors with splash proof or weatherproof housing where required or recommended by the manufacturer.
 - 3. Furnish TEFC motors for exposed outdoor installations and corrosive environments.
 - 4. Furnish TEAO motors when located in airstream of equipment serving corrosive environments.
 - 5. Furnish Severe Duty motors complying with IEEE-841 standards for severe duty and hazardous locations.
- D. All motors shall be furnished for starting in accordance with utility requirements, and shall be compatible with starters, as specified under Division 26 specifications.
- E. Motors located inside air handling units in a clean airstream may be ODP motors.

2.2 MOTOR CHARACTERISTICS

- A. Refer to the equipment schedules and specification sections for specific voltages required.
- B. All motors shall be 1750 RPM, unless otherwise noted and selected to operate at or below nameplate amps.
- C. Polyphase motors for direct drive applications with variable frequency drives with bypass feature shall be selected at a speed equal to or less than the design speed of the fan or pump. Motors shall be selected to allow operation at full speed and on bypass at 60 hertz without exceeding nameplate ratings.
- D. Motors 1 horsepower and larger shall be premium efficiency or EC permanent magnet type.
- E. Motors shall meet or exceed efficiency levels per energy code for intended duty.
- F. Duty: Continuous duty at ambient temperature of 104 deg F and at altitude of 3300 feet above sea level.
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at full speed, at installed altitude and environment, with indicated operating sequence and design criteria without exceeding nameplate ratings or considering service factor.

- H. Provide electronically commutation (EC) single or three phase permanent magnet motors with integral EC motor controller or polyphase motors with variable frequency drive for variable speed applications. Speed control by 0-10 VDC signal or dial mounted potentiometer for automatic control and test and balance.
- I. EC motors shall be selected to allow full speed operation without exceeding nameplate amp rating.

2.3 PREMIUM EFFICIENCY POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
 - 1. Efficiency: Meet or exceed the most stringent of the applicable Energy Code, NEMA Premium efficiency standards, as defined in NEMA MG 1 or the efficiencies listed below when tested in accordance with IEEE Standard 112, Method B procedures as stated in NEMA MG 1-12.53a.

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
Number of Poles	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
RPM	1200	1800	3600	1200	1800	3600
HP						
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4
250	95.4	95.8	95.0	95.8	96.2	95.8
300	95.4	95.8	95.4	95.8	96.2	95.8
350	95.4	95.8	95.4	95.8	96.2	95.8
400	95.8	95.8	95.8	95.8	96.2	95.8
450	96.2	96.2	95.8	95.8	96.2	95.8
500	96.2	96.2	95.8	95.8	96.2	95.8

- B. Service Factor: 1.15.
- C. Multispeed Motors: Separate winding for each speed.
- D. Rotor: Random-wound, squirrel cage.
- E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Class B.
- G. Insulation: Class F.
- H. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- J. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- K. Motors Used with Variable Frequency Drives: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 3. Thermal Protection: Comply with NEMA MG 1 Part 31 requirements for thermally protected motors.
 - 4. Motors connected to variable frequency drives shall have shaft grounding devices meeting the following requirements
 - a. Shaft grounding shall be a bearing isolator, or labyrinth seal, that includes a built-in grounding ring and brush. The brush shall contain conductive microfibers that completely surround the shaft to discharge any current flowing through it.
 - b. Motors less than 100 HP size shall be provided with a single shaft grounding ring provided on the drive end of the motor.
 - c. Motors 100 HP size and larger shall be provided with a shaft grounding ring on both ends of the motor shaft or shall have an insulated ceramic bearing installed on the non-drive end of the motor and a shaft grounding ring installed on the drive end of the motor.
 - d. Apply a fast drying silver paint on the shaft surface to prevent corrosion.
 - e. Shaft grounding ring wear shall be less than 0.001" in 10,000 hours with a fiber wear length designed for expected life 200,000+ hours based on testing. Shaft grounding rings shall be compatible with operating environments ranging from -40° F to 300° F and 0-90% RH (non-condensing).
 - f. AEGIS SGR™ Bearing Protection Ring as manufactured by Electro Static Technology (EST).

2.4 SINGLE-PHASE MOTORS

- A. Motors 1 HP and below shall be single-phase motors minimum 70% efficient to 1/12 HP, unless scheduled otherwise.
- B. Motors shall be one of the following types as required for the application and/or as scheduled, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Capacitor start, capacitor run.
 - 3. Electronic commutation (EC).
- C. Multispeed Motors: Variable-torque, permanent-split-capacitor type or electronic commutation type.
- D. Variable Speed applications: Electronic commutation type.
- E. Bearings: Permanently lubricated and sealed, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading. Motors 1/8 HP and below may be shaded pole type with permanently oiled unit bearings.
- F. Thermal Protection: Internal thermal overload protection for single phase motors to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- G. Separate Overload Device: Manufacture to include a fused controller or other separate overload device integral to the equipment for motors without internal thermal overload protection.
- H. EC Motors: Motors to be brushless DC electronically commutated permanent magnet type designed for direct drive applications with minimum 80% efficiency at all speed settings. Factory mounted integral motor controller with transformer and speed control down to 20% full speed utilizing a 0-10 VDC signal. Motor controller includes factory programming, user interface, operational status indicators and motor status switch.
 - 1. For constant volume applications, speed controller to be either integral or remote mounted speed controller manual dial type potentiometer.
 - 2. For variable volume applications, motor speed shall be automatically controlled by a 0-10 VDC signal from the control system.

2.5 POLYPHASE EC MOTOR

- A. Motors to be three phase brushless DC electronically commutated permanent magnet type designed for direct drive applications with operation to 20% full speed. Factory mounted integral motor controller with transformer, controls, user interface and integrated power factor correction for low input harmonic current distortion.
- B. Efficiency of EC motor at full speed and part speed to meet or exceed the efficiency levels as specified above for premium efficiency polyphase induction motors.
- C. Maintenance-free sealed ball bearings with long term lubrication.
- D. Insulation Class: "F" or better.
- E. NEMA motor frames or axial flux design for compact plenum fans.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Examples of severe duty spaces would include but not be limited to industrial applications and chemical processing.

3.2 INSTALLATION

- A. Install materials in accordance with details, approved shop drawings, and manufacturer's instructions.
- B. Verify thermal overload or overcurrent protection is provided for motors.

END OF SECTION 230513

SECTION 230523 - GENERAL-DUTY VALVES FOR HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bronze Ball valves
 - 2. Gate Valves
 - 3. Butterfly Valves
 - 4. Check Valves
 - 5. Calibrated Balancing Valves
 - 6. Automatic Flow Control Valves
 - 7. Chainwheels
- B. Related Sections include:
 - 1. Division 23 Section "Hydronic Piping".
 - 2. Division 23 Section "Hydronic Piping Specialties".

1.3 PERFORMANCE REQUIREMENTS

- A. Products shall be suitable for the indicated service including piping system fluids, materials, pressures, and temperatures.
- B. Hydronic valves and installation shall withstand the minimum design pressure and temperature and test pressure as specified in Division 23 Section "Hydronic Piping."

1.4 DEFINITIONS

- A. EPDM: Ethylene propylene copolymer rubber.
- B. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- C. NRS: Nonrising stem.
- D. OS&Y: Outside screw and yoke.
- E. RS: Rising stem.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of valve indicated, provide product data including applicable dimensions, capacities, materials of construction, non-compatible fluids and pressure and temperature ratings..

1.6 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
 - 1. Grooved end valves shall be of the same manufacturer as the adjoining couplings
- B. Hydronic piping and valves shall be fabricated and installed to comply with ASME.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Hydronic valves and installation shall be suitable for indicated service with design pressure and temperature ratings as indicated in Part 1 "Performance Requirement" Article.
- B. Hydronic piping, valves and installation shall withstand 1.5 times the system's working pressure for pressure test requirements.
- C. Finish: Manufacturer's standard paint or galvanized construction to resist corrosion for valves constructed of steel.

- D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Obtain each type of valve from single source from single manufacturer.
- F. MANUFACTURERS: For ball valves, gate valves, check valves, and butterfly valves, Powell, Apollo, Bray, Crane, Nibco, Jenkins, Hammond, Stockham, Red-White Valve Corp., Lunkenheimer, Milwaukee, Mueller Steam, Kitz and Victaulic. For other valves, acceptable manufacturers are listed under each item.
- G. Valves used in PEX systems may be of the same manufacturer as the piping system with utilizing the compatible PEX fitting end connections.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
 - 5. Memory Stop: Include manufacturer's memory stop for all manual balancing valves and for butterfly valves used as balancing valves.
- J. Valves in Insulated Piping: With stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- K. Valve-End Connections:
 - 1. Threaded ends for NPS 2 and smaller.
 - 2. Flanged or grooved ends for NPS 2-1/2 (DN 65) and larger.
 - 3. Valve ends may be pressure seal or grooved when specified for fittings in Hydronic Piping.
 - 4. Drain, vent and blow down valves NPS 3/4 (DN20) and smaller: provide with 3/4" hose end connection with cap and chain, unless piping is extended to drain.
 - 5. Drain, vent and blow down valves NPS 1 (DN25) to NPS 2 (DN50): provide with line size cap or plug, unless piping is extended to drain.
 - 6. Future pipe connections all sizes: provide line sized isolation valve with spool piece and end cap.

2.2 BALL VALVES

- A. Bronze Two-Piece Full-Port Ball Valves for NPS 2 (DN50) and smaller:
 - 1. Description:
 - a. Standard: MSS SP-110.

- b. Body Design: Two piece
- c. Body Material: Bronze
- d. Seats: PTFE or TFE.
- e. Stem: Bronze or stainless
- f. Ball: Chrome-plated brass or stainless
- g. Port: Full

2.3 GATE VALVES

A. Bronze Gate Valves for NPS 2 (DN50) and smaller:

- 1. Description: rising or non rising stem:
 - a. Standard: MSS SP-80, Type 1 or Type 2.
 - b. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - c. Stem: Bronze.
 - d. Disc: Solid wedge; bronze.
 - e. Packing: Asbestos free.
 - f. Handwheel: Malleable iron, bronze, or aluminum.

B. Iron Gate Valves for NPS 2-1/2 (DN65) and larger:

- 1. Description: Outside Screw and Yoke:
 - a. Standard: MSS SP-70, Type 1.
 - b. Body Material: ASTM A 126, ductile or cast iron with bolted bonnet.
 - c. Trim: Bronze.
 - d. Disc: Solid wedge, ductile or cast iron.
 - e. Packing and Gasket: Asbestos free.
 - f. Handwheel: Malleable iron.

2.4 BUTTERFLY VALVES

A. Butterfly Valves for NPS 2-1/2 (DN65) and larger:

- 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. Body Design: Suitable for bidirectional dead-end service with bubble tight shut off at rated pressure.
 - c. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - d. Seat: EPDM or NBR
 - e. Stem: One- or two-piece stainless steel.
 - f. Disc: Aluminum bronze or stainless steel.
 - g. Seal: EPDM or NBR

B. High-Performance Butterfly Valves for NPS 2-1/2 (DN65) and larger:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bray Controls; a division of Bray International.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. DeZurik Water Controls.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corp.
2. Description:
 - a. Standard: MSS SP-68.
 - b. Body Design: Suitable for bidirectional dead-end service with bubble tight shut off at rated pressure.
 - c. Body Material: ASTM A216 carbon steel.
 - d. Seat: Reinforced PTFE.
 - e. Stem: One piece stainless steel.
 - f. Disc: Stainless steel.
 - g. Seal: PFTE.

C. Operators:

1. Standard ten-position locking type hand lever operator with position indicator and when indicated memory stop for valve sizes NPS 6 (DN 150) and smaller.
2. Standard gear operator with position indicator and when indicated memory stop for valve sizes NPS 8 (DN200) and larger.

2.5 CHECK VALVES

A. Bronze Swing Check Valves for NPS 2 (DN50) and smaller:

1. Description:
 - a. Standard: MSS SP-80
 - b. Body Design: Horizontal flow.
 - c. Body Material: ASTM B 62, bronze.
 - d. Disc: Bronze, PTFE, or TFE, renewable.
 - e. Bonnet: Screwed.

B. Swing Check Valves for NPS 2 ½ (DN65) and larger:

1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. Body Design: Clear or full waterway.
 - c. Body Material: ASTM A 126, cast iron with bolted bonnet.
 - d. Trim: Bronze.

- e. Disc: Bronze or Ductile Iron, renewable.
- f. Seat: Bronze, renewable.
- g. Gasket: Asbestos free.

C. Swing Check Valves with Lever and Weight-Closure Control for NPS 2 ½ (DN65) and larger:

1. Description:

- a. Standard: MSS SP-71, Type I.
- b. Body Design: Clear or full waterway.
- c. Body Material: ASTM A 126, cast iron with bolted bonnet.
- d. Trim: Bronze.
- e. Disc: Bronze or Ductile Iron, renewable.
- f. Seat: Bronze, renewable.
- g. Gasket: Asbestos free.
- h. Closure Control: Factory-installed, exterior lever and weight.

D. Bronze Spring Actuated Center-Guided Check Valves for NPS 2 (DN 50) and smaller:

1. Description:

- a. Standard: MSS SP-125.
- b. Body Design: Compact wafer with spring loaded non-slam single disc.
- c. Body Material: ASTM A 62 bronze.
- d. Trim: Bronze with stainless steel spring.
- e. Disc: Bronze or nickel-plated ductile iron.
- f. Seat: EDPM or NBR

E. Spring Actuated Dual Plate Check Valves for NPS 2 (DN 50) and larger:

1. Description:

- a. Standard: API 594.
- b. Body Design: Compact wafer with spring loaded non-slam dual plates (dual disc).
- c. Body Material: ASTM A 126 ductile iron.
- d. Trim: Bronze with stainless steel spring.
- e. Disc: Bronze.
- f. Seat: EDPM or NBR.

2.6 Calibrated Balancing Valves

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Bell & Gossett Domestic Pump; a division of ITT Industries.
- 2. Flow Design Inc.
- 3. Griswold Controls.
- 4. Hays Fluid Controls.

5. Oventrop Corporation.
6. Red-White Valve Corp.
7. Taco.
8. Victaulic

B. Venturi Balancing Valve NPS 2 (DN50) and smaller:

1. Description:

- a. Body Design: Ball type 1- piece valve with calibrated venturi.
- b. Body Material: Bronze.
- c. Valve: Suitable for shut off.
- d. Seat: PTFE.
- e. End Connections: Threaded.
- f. Stem: Bronze or stainless.
- g. Ball: Chrome-plated brass or stainless.
- h. Port: Full.
- i. Pressure Gage Connections: Integral seals for portable differential pressure meter.
- j. Handle Style: Lever, with memory stop to retain set position.
- k. Venturi: Low pressure loss high pressure signal type.
- l. Accuracy: Plus or minus 3 %.
- m. Insulation: Shipping container designed for use as insulation with minimum R of 4.5 and 25/50 fire smoke rating.

C. Venturi Balancing Valve NPS 2 1/2 (DN65) and larger:

1. Description:

- a. Body Design: Lug type butterfly valve with calibrated venturi.
- b. Body Material: Cast or ductile iron valve and carbon steel venturi.
- c. Valve: With bubble tight shut off at rated pressure.
- d. Seat: EPDM or NBR.
- e. End Connections: Flanged.
- f. Stem: One or two-piece stainless.
- g. Disc: Aluminum Bronze or stainless.
- h. Pressure Gage Connections: Integral seals for portable differential pressure meter.
- i. Handle Style: Lever, with memory stop to retain set position.
- j. Venturi: Low pressure loss high pressure signal type.
- k. Accuracy: Plus or minus 3 %.

D. Test Meter:

1. Provide portable test meter kit either analog or digital gage with reading range from 0" to 50" water column, plus or minus 2% accuracy with hoses and pressure port connectors. Test meter to become property of the Owner.

2.7 AUTOMATIC FLOW-CONTROL VALVES:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bell & Gossett Domestic Pump; a division of ITT Industries.
 2. Flow Design Inc.
 3. Griswold Controls.
 4. Hays Fluid Controls.
 5. Oventrop Corporation.
 6. Red-White Valve Corp.
 7. Victaulic Company.
- B. Automatic Flow-Control Valve NPS 2 1/2 (DN65) and smaller:
1. Description:
 - a. Body Design: Flow limiting type with offset screwed cap to allow removal of flow limiting cartridge without disconnecting piping.
 - b. Optional GPM dial: Integral GPM dial to allow field adjustment of cartridge and maximum GPM without changing cartridge.
 - c. Body: Brass.
 - d. Cartridge: Brass Body, 304 Stainless steel spring, EPDM seals non clogging design where cartridge never fully seats.
 - e. End Connections: Threaded.
 - f. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - g. Accuracy: Plus or minus 5% over an operating pressure differential of 2 psi to 32 psi.
 - h. Capacity: Select the GPM for 10% more than listed in the equipment schedules.
 - i. Optional combination Assemblies: Include integral bronze ball valve.
 - j. Insulation: Shipping container designed for use as insulation with minimum R of 4.5 and 25/50 fire smoke rating.
- C. Automatic Flow-Control Valve NPS 3 (DN75) and larger:
1. Description:
 - a. Body Design: Flow limiting type wafer to allow removal of flow limiting cartridge.
 - b. Body: Cast Iron with lifting lug.
 - c. Cartridge: Multiple cartridge design, brass body, 304 Stainless steel spring, EPDM seals non clogging design where cartridge never fully seats.
 - d. End Connections: Wafer type for installation between flanges.
 - e. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - f. Accuracy: Plus or minus 5% over an operating pressure differential of 2 psi to 32 psi.
 - g. Capacity: Select the GPM for 10% more than listed in the equipment schedules.

D. Test Meter:

1. Provide portable test meter kit either analog or digital gage with reading range from 0 to 60 psi, plus or minus 2% accuracy with hoses and pressure port connectors. Test meter to become property of the Owner.

2.8 HOSE KITS

- A. General: Complete coil hook-ups for valve systems 3/4" to 2" consisting of threaded end connections, unions, full port ball valves, Y-strainers, automatic flow control valves, pressure/temperature test ports, air vents, drain valves and flexible hose connectors may be utilized in lieu of individually specified components. Coil hook-ups shall be manufactured by Bell and Gossett, Flow Design Inc., Griswold, Hays Fluid Controls, HCl, Nexus, Nibco, Oventrop Corporation, Red-White Valve Corp. or Victaulic. Coil hook-up kits shall be same size as piping runout to equipment not equipment connection size.
- B. Hose kits shall be designed for minimum 400 psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
- C. Hose: Minimum diameter, equal to pipe runout size not unit connection size.
- D. Refer to Piping Connection details for required valves and components and their arrangement.

2.9 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Refer to drawings for additional requirements for piping connections and details.

3.2 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 VALVE APPLICATIONS

- A. Valves and installation shall suitable for indicated service with design pressure and temperature ratings as indicated in Part 1 "Performance Requirements" Article.
- B. Valves to be compatible with associated piping systems utilizing screwed or flanged ends and utilizing transition fittings for piping connections as required. Valves may utilize pressure seal or grooved connections in piping specifications.
- C. Provide stainless steel construction for steel valves when used on piping systems in corrosive environments. Refer to Division 23 Section "Hydronic Piping" for systems considered corrosive.
- D. Shutoff Service: Ball, gate or butterfly valves
- E. Drain Valves: Ball or gate valves.
- F. Pump-Discharge Check Valves: Spring Actuated.
- G. Install calibrated or automatic flow control valves in the return pipe of each heating or cooling terminal.
 - 1. Calibrated balancing valves and automatic flow control valves shall not be used on equipment where pressure independent control valves are installed.
- H. Provide memory stop for all balancing valves including pump discharge valves.
- I. Valves to be compatible with associated piping systems utilizing soldered, brazed, press fittings, grooved, screwed, welded, flanged and plastic fittings as indicated in part 2 specifications.

3.5 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Install shutoff valves at all equipment, at each branch take-off from mains and sub-mains, at the base of each riser serving multiple floors and at each automatic valve for servicing.
- C. Install shut off valve upstream of each air vent to permit isolation of the air vent.
- D. Compliance: In accord with approved submittals and manufacturer's written instructions.
- E. Locate valves for easy access and provide separate support for all valves NPS 4 and larger.
- F. Install valves in horizontal piping with stem at or above center of pipe.
- G. Install valves in position to allow full stem movement.
- H. Install chainwheels and gear operators for valves NPS 4 and larger when located more than 96 inches above equipment room floor. Extend chains to 60 inches above finished floor.
- I. Provide valve boxes or manholes for all valves installed underground.
- J. Provide chained caps at all vent and drain manual valves unless vent or drain is piped to a drain.

- K. Future pipe connections all sizes: provide line sized isolation valve with spool piece and removable screwed, flanged or grooved end cap for future piping connections. Length of spool piece as required to make future connection. Isolation valve to be set in open position.
- L. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Spring Actuated Check Valves: In horizontal or vertical position.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

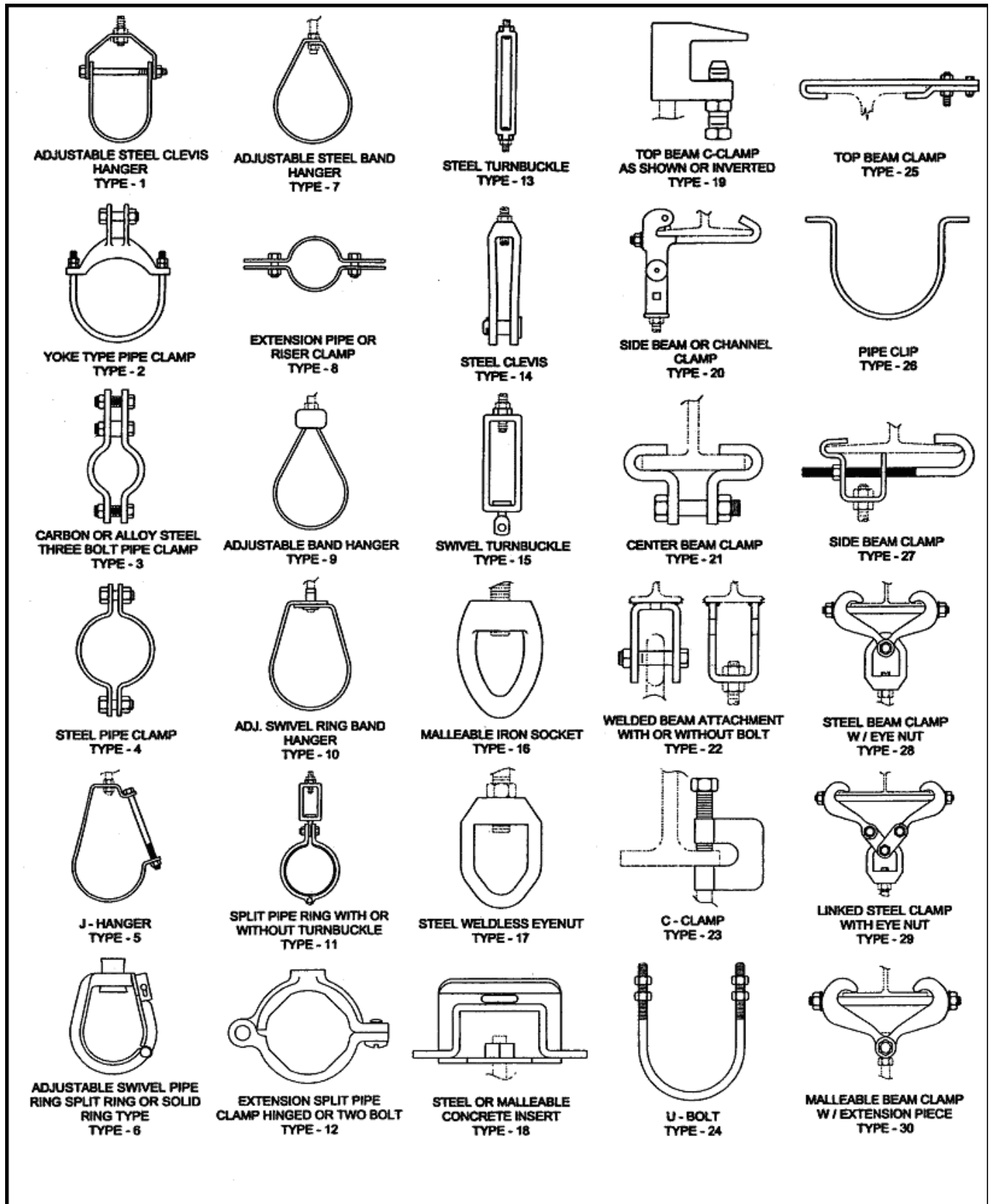
- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

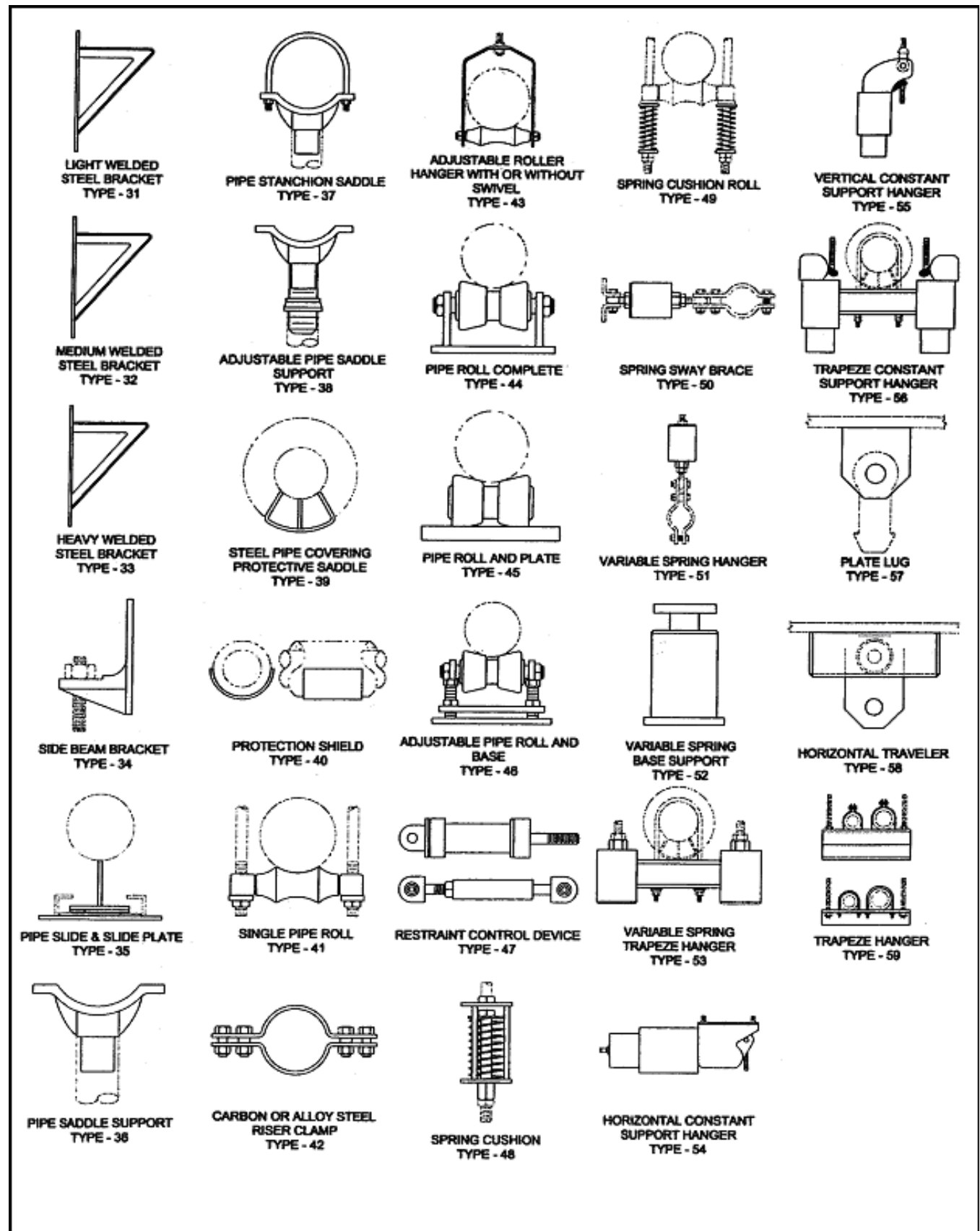
1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system ductwork, piping and equipment:
 - 1. Roof equipment curb supports
 - 2. Roof pipe penetrations
 - 3. Pipe hangers and supports.
 - 4. Trapeze pipe hangers.
 - 5. Fastener systems.
 - 6. Pipe stands.
- B. Related Sections include:
 - 1. Division 23 Section "Vibration Controls for HVAC."
 - 2. Division 23 Section "Hydronic Piping".

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Description: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports", refer to the following figures when the "Type" hanger or support is indicated in Part 2 and 3 of this specification.





1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: Hangers and supports for HVAC piping and equipment shall withstand the effects of loads and stresses within limits and under conditions indicated according to ASCE 7. Design piping and equipment supports, including pipe stands, to support combined loads of supported systems, equipment and system contents.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of hanger and support indicated including:
 - 1. Pipe, duct or equipment hanger: Type of lower attachment, hanger rod, upper attachment and building attachment.
 - 2. Pipe, duct or equipment support, pedestal or stand: Type of attachment, support and building attachment.
 - 3. Indicate materials, finishes, approvals and load ratings
- B. Shop Drawings: Show fabrication and installation details coordinated with and sized for the associated piping, ductwork and equipment supported.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.
- B. Manufacturers Standardization Society: Hangers and supports in conformance with MSS including:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.7 DESIGN CRITERIA

- A. Size, select and install hangers and supports in accordance with MSS, unless otherwise specified.
- B. When this specification includes both insulation protection shields and thermal pipe shields. Contractor may use either device, coordinated with insulation specifications.

- C. Contractor is responsible for proper placement of supporting devices to accommodate insulation and pitching of pipe as specified in other sections.
- D. Where piping can be conveniently grouped to allow the use of trapeze type supports, the supporting steel shall be by means of standard structural shapes or continuous insert channels.
- E. For non-corrosive service, all upper attachments, hangers, supports, rods and other devices shall be of galvanized construction.
- F. For corrosive service, all upper attachments, hangers, supports, rods and other devices shall be of stainless steel, aluminum or fiberglass construction.

PART 2 - PRODUCTS

2.1 EQUIPMENT SUPPORTS

- A. Provide all supporting steel, not indicated on the structural drawings, that is required for the installation of mechanical equipment, ductwork, piping and materials, including angles, channels, beams, etc., to suspend or floor support ductwork, piping tanks and equipment

2.2 ROOF EQUIPMENT CURB SUPPORTS

- A. Provide factory fabricated equipment curbs for roof mounting of mechanical equipment.
- B. Roof equipment curb shall be manufactured of heavy gauge galvanized steel with fully mitered and welded corners, internally reinforced with integral baseplate, 1-1/2" thick, 3 lb. density fiberglass insulation, and factory installed wood nailer. Height to be as required to maintain height above finished roof indicated.
- C. Equipment curbs shall be level at top with built-in slope when roof deck slopes.

2.3 ROOF PIPE PENETRATIONS

- A. General: Roofing penetrations used shall be in compliance with project details and roofing manufacturer's requirements, methods and approved details.
- B. Curb Type: Consisting of a EPDM protective rubber cap for single or multiple insulated and non-insulated pipes, stainless steel clamps, galvanized, stainless or aluminum curb cover and prefabricated insulated roof curb. Provide high temperature rubber cap as required to meet the application.
- C. Portal Type: Consisting of a EPDM protective rubber cap for single or multiple insulated and non-insulated pipes, pipe stand supports, stainless steel clamps, plastic or aluminum portal base designed to seal to roofing membrane. Provide high temperature rubber cap as required to meet the application.
- D. Hood Type: Consisting of a galvanized, stainless steel or aluminum heavy gauge metal hood and prefabricated insulated roof curb sized for number and size of pipes.

2.4 PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components with shields for insulated piping. Constructed of galvanized steel, stainless steel, copper coated, plastic coated or aluminum.

2.5 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts with shields for insulated piping. Constructed of galvanized steel, stainless steel, copper coated, plastic coated or aluminum.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated (stainless steel in corrosive environments), for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- C. Concrete Screw Anchors: Screw insert type high strength carbon steel zinc-plated for use in interior not corrosive environments for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Hilti Kwik – HUZ-EZ series or approved equal.
- D. Internally Threaded Anchor for Installation into Metal Deck: Concrete anchor shall be carbon steel, cast-in type with single internal thread and a zinc/yellow chromate plating. Anchor shall have a protective sleeve, steel flange with pre-drilled additional fastening holes and placement spring for attachment to metal deck, anchor is to be secured by clamping the deck between the steel flange and the protective plastic sleeve. Anchor shall bear the diameter and the manufacturer name on hexagonal head.
- E. Internally Threaded Anchor for Installation into formed wood concrete deck: Concrete anchor shall be carbon steel, cast-in type with single internal thread and a zinc/yellow chromate plating and contained by a plastic flange. Anchor shall have break-off nails for attachment to the surface of wood forms. Anchor will bear the diameter and manufacturer name on hexagonal head.

2.7 PIPE STANDS

- A. General: Pipe stands to be factory or shop fabricated utilizing pipes or struts to support piping, ductwork or equipment at the roof level. Roofing penetrations used shall be in compliance with project details and roofing manufacturer's requirements, methods and approved details.
- B. Pipe Stands: Shop fabricated assemblies constructed of galvanized steel, stainless steel or aluminum designed by delegated contractor to support and tie down roof-mounted equipment, ductwork and piping. Stands bases to be secured to structure. Roof stands to pipe supports to either secure to structure or connect to roof curb or roof rail.

C. Pipe Stands Zero Roof Penetration Type:

1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
2. Pipe stand supports to be trapeze type or clevis type pipe hangers as specified above, detailed and to meet the application including provisions for piping expansion. Piping to be supported with rollers per Part 3 requirements.
3. Pipe stand supports and all thread rod to be constructed of galvanized steel, stainless steel or aluminum.
4. Compact Pipe Stand: One-piece plastic unit with integral pipe support, for roof installation without membrane penetration.
5. Low-Type Stand: Plastic base unit, all thread rod for adjustable height strut for trapeze pipe or duct support, for roof installation without membrane penetration.
6. High-Type Pipe Stand: Plastic base, assembly of vertical and adjustable height horizontal members for cleaves hanger type pipe support, for roof installation without membrane penetration.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT, GENERAL

- A. Install and size pipe support, hanger rod, pipe stand and upper attachments suitable for indicated service with performance and design criteria as indicated in Part 1 "Performance Requirements" Article.
- B. Select type pipe support, hanger rod, and upper attachment to accommodate piping axial movement due to thermal expansion or building movement as indicated in Part 1 "Performance Requirements" Article. For individual piping supports with fixed pipe support, small axial motion may be absorbed by swing of hanger rod up to the greater of a maximum of 4 degrees or manufacturer's recommendations.
- C. Materials
 1. Use hangers and supports with galvanized, metallic coatings for normal service piping and equipment that will not have field-applied finish.

2. Use stainless-steel, aluminum or fiberglass hangers and supports for corrosive service.
 3. Use vinyl ester resin fiberglass for "ozone" applications.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Plastic coated, plastic inserts or copper-plated hangers shall be provided for copper piping in direct contact with hangers.
- F. Hangers and supports for piping connected in conjunction with rotating or reciprocating equipment shall be spring hangers and supports for a distance of 100-pipe diameters, or a distance of three hangers away from rotating or reciprocating equipment whichever is greater. Isolators shall be as specified under Vibration Isolation.
- G. For pipes, ducts and equipment supported above the roof, provide pipe stands or struts at lengths as required to maintain minimum height above the roof per the Building Code. Provide tie downs per the building code with equipment utilizing bolted or rigid clip tiedowns, unless restrained type vibration isolation is required by vibration isolation specifications. Include installation of additional tie down straps over equipment when required by the AHJ. Provide water proof seal at roof and wall penetration.

3.2 HANGER AND SUPPORT SCHEDULE

- A. Horizontal-Piping Hangers: Unless otherwise indicated , install the following types:
1. Adjustable, Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated individual piping:
 - a. All systems NPS 2and smaller.
 - b. Ambient and cold systems (119deg F and below) NPS 2 1/2and above not subject to thermal movement.
 2. Adjustable, Roller Hangers (MSS Type 43): For suspension of noninsulated or insulated individual piping:
 - a. Hot systems (120deg F and above) NPS 2 1/2and above subject to thermal movement.
 - b. All systems NPS 2 1/2and above subject to thermal movement.
 3. Adjustable Trapeze Hangers (MSS Type 49): For suspension of noninsulated or insulated multiple horizontal piping.
 - a. Trapeze support selected and sized for associated loads suitable for mounting each pipe with (MSS Type 24) standard U-Bolt pipe strap, strut mounted pipe guide or (MSS Type 41 or 44) pipe roller.
 - b. Pipe strap (MSS Type 24) for all systems NPS 1 1/2and smaller.
 - c. Pipe strap (MSS Type 24) for ambient and cold systems (119deg F and below) NPS 2and above not subject to thermal movement.
 - d. Pipe roller (MSS Type 41 or 44) for hot systems (120deg F and above) NPS 2and above subject to thermal movement.
 - e. Adjustable type pipe support for individual piping which requires a specific slope.

- B. Horizontal-Piping Supports: Unless otherwise indicated, install the following types when supporting noninsulated or insulated pipe from below either in equipment rooms or at exterior locations:
1. Adjustable, Pipe Stanchion Saddles (MSS Type 38): For support of individual pipes, NPS 4 and larger not subject to thermal movement, with adjustable steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 2. Adjustable, Pipe Saddle Supports (MSS Type 37): For support for individual pipes, NPS 2 to NPS 8 not subject to thermal movement, with all thread rod for height adjustment and U-bolt to retain pipe.
 3. Pipe rails or Pipe Stands: For support of multiple horizontal piping.
 - a. Rail or stand support selected and sized for associated loads suitable for mounting each pipe with (MSS Type 24) standard U-Bolt pipe strap, strut mounted pipe guide or (MSS Type 41 or 44) pipe roller.
 - b. Pipe strap (MSS Type 24) for all systems NPS 1 1/2 and smaller.
 - c. Pipe strap (MSS Type 24) for ambient and cold systems (119deg F and below) NPS 2 and above not subject to thermal movement.
 - d. Pipe roller (MSS Type 41 or 44) for hot systems (120deg F NPS 2 and above subject to thermal movement.
 - e. Adjustable type pipe support for individual piping which requires a specific slope.
- C. Wall-Piping Supports: Unless otherwise indicated, install the following types when supporting noninsulated or insulated pipe from walls either in equipment rooms or at exterior locations:
1. Pipe Stands: For support of multiple horizontal piping either cantilever (MSS type 31, 32, 33) or racked vertically.
 - a. Pipe stand support selected and sized for associated loads suitable for mounting each pipe with (MSS Type 24) standard U-Bolt pipe strap, strut mounted pipe guide or (MSS Type 41 or 44) pipe roller for horizontal cantilever pipe stand..
 - b. Pipe strap (MSS Type 24) for all systems NPS 1 1/2 and smaller.
 - c. Pipe strap (MSS Type 24) for ambient and cold systems (119deg F and below) NPS 2 and above not subject to thermal movement.
 - d. Pipe roller mounted on horizontal cantilever pipe stand (MSS Type 41 or 44) for hot systems (120deg F and above) NPS 2 and above subject to thermal movement.
 - e. Adjustable type pipe support for individual piping which requires a specific slope.
- D. Vertical-Piping Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
 3. Piping larger than 4", of lengths exceeding 30 feet, shall be additionally supported on base elbows secured to the building structure, with flexible supporting hangers, provided at top of riser to allow for pipe expansion in accord with vibration controls specifications.

- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types suitable for threaded hanger rod connections:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations suitable to accommodate piping axial movement.
 - 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments suitable for piping with little to no axial movement.
 - 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations suitable to accommodate piping axial movement where swivel action is required.

- F. Building Attachments: Unless otherwise indicated, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 - 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 - 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the types as indicated in Installation section of this specification.

- H. Spring Hangers and Supports:
 - 1. Spring isolators for hangers and supports are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment".

3.3 HANGER AND SUPPORT INSTALLATION

- A. Install supporting devices as shown on the drawings, as detailed, and according to manufacturer's installation instructions.
- B. Coordinate support of mechanical, plumbing, electrical, life support systems, and other trades. Piping, ductwork, conduit, etc. located in same area running parallel is to be supported on similar supports.
- C. Roof Curb Supports installation: Position and attach equipment rails and curbs with structure as detailed. Provide field installed fiber cant strip, flash and counter flash roofing membrane.
 - 1. Size equipment rails and/or equipment curbs to support associated equipment. For equipment rails, contractor may submit alternate method utilizing a full perimeter curb for equipment support for engineer's review.
 - 2. Install roof curbs in accordance with manufacturer's instruction of equipment supported.
- D. Pipe Roof Penetrations: Install as detailed on the drawings at points where pipes are penetrating roof. Size pipe roof penetrations to accommodate associated piping. Provide water proof seal and air seal at roof penetration. Contractor may submit alternate method for engineer's review.
- E. Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- F. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- G. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 - 3. Install concrete screw anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 - 4. Install anchors for metal decking and wood forms prior to the concrete pour according to the manufacturer's instructions.
- H. Pipe Stand Installation:
 - 1. Pipe Stands: Assemble stand components as detailed on the drawings complete with anchors for positive attachments from structure to support to supported equipment. Provide water proof seal at roof penetration.

2. Roof Curb or Rail Mounted Type: Assemble stand components as detailed on the drawings complete with anchors for positive attachments from structure to support to supported equipment.
 3. Zero penetration pipe supports are acceptable for pipe sizes to NPS 2 1/2 and smaller.
-
- I. Install hangers and supports complete with necessary upper attachments, inserts, bolts, rods, nuts, washers, and other accessories.
 - J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - K. Support apparatus and material for all conditions of operation, including variations in installed and operating weight of equipment and piping.
 - L. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
 - M. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - N. Install building attachments within concrete slabs or attach to structural steel or structural wood. Install additional attachments within 1 foot of elbows and at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
 - O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
 - Q. Insulated Piping: Comply with the following:
 1. Risers: Attach riser clamps and spacers to piping.
 - a. Attach riser clamp to piping and insulate pipe and clamp for chilled water systems and hot systems with service temperatures above 140 deg F.
 - b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 2. Horizontal Piping: Install hangers and guides to piping.
 - a. Protective Shields: MSS SP-58, Type 40, shields on cold and hot piping. Shields shall span an arc of 180 degrees with length sufficient to prevent compression of insulation and associated loss of R-Value.
 - b. Protective Saddles: MSS SP-58, Type 39, saddles on hot piping systems and fill interior voids with insulation. Provide with protective shield spanning an arc of 180 degree with length sufficient to accommodate thermal movement of piping.
 - c. Thermal-hanger Shield Inserts (Insulated Pipe Supports): Insulated pipe supports with insulation same thickness as associated piping insulation may be used for cold and hot piping with protective shield spanning an arc of 180 degree with length sufficient to accommodate thermal movement of piping.
 3. Shield Dimensions for Pipe: Length as required for insulation or expansion and not less than the following:

- a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
- b. NPS 4: 12 inches long and 0.06 inch thick.
- c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
- d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
- e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

3.4 HANGER AND SUPPORT SPACING

- A. Install and size hangers and supports for piping systems to meet maximum spacing requirements of the Building Code. Alternate longer spacing per MSS SP-69 are acceptable subject to approval of Authority Having Jurisdiction and subject to structural loading capacity of structure supporting the piping systems. Size hanger rods, trapeze supports, to support the associated loads.
- B. Install hangers and pipe stands for steel piping with the following maximum spacing :
 1. NPS 3/4: Maximum span, 7 feet.
 2. NPS 1: Maximum span, 7 feet.
 3. NPS 1-1/2: Maximum span, 9 feet.
 4. NPS 2: Maximum span, 10 feet.
 5. NPS 2-1/2: Maximum span, 11 feet.
 6. NPS 3 and Larger: Maximum span, 12 feet.
- C. Install hangers and pipe stands for drawn-temper copper piping with the following maximum spacing :
 1. NPS 3/4: Maximum span, 5 feet.
 2. NPS 1: Maximum span, 6 feet.
 3. NPS 1-1/2 and NPS 2 Maximum span, 8 feet.
 4. NPS 2-1/2: Maximum span, 9 feet.
 5. NPS 3: Maximum span, 10 feet.
- D. Multiple Pipes of Various Sizes: When supported together on a common trapeze, rail or pipe stand, space for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- F. Support vertical pipe risers less than 30 feet at roof, at each floor, and at additional intervals as required to limit loading on building structure.

3.5 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.6 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.7 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1 inch.

3.8 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230550 – VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes items for structural vibration isolation and includes the following:
 - 1. Mounts.
 - 2. Bases.
 - 3. Hangers.
 - 4. Restraints.
 - 5. Anchors and guides.
 - 6. Flexible pipe connections.

1.3 ACTION SUBMITTALS

- A. Product Data: Provide schedule and product data of isolation devices related to the equipment served. Schedule and data shall indicate isolation materials, isolator heights both free and operating, isolator dimensions, deflections, and isolation efficiency based on lowest operating speed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Products and methods of fabrication, subject to compliance with requirements, provide products by one of the following:
 - 1. Mason Industries
 - 2. Kinetics Noise Control
 - 3. Korfund Company
 - 4. Amber-Booth Company
 - 5. Victaulic

2.2 MATERIALS

- A. All isolation devices shall be designed for the equipment with which they will be used. Materials used shall retain their isolation characteristics for the life of the equipment served. All elastomeric materials shall be industrial grade neoprene. Isolation devices subject to weather shall have hot dipped galvanized finish.

2.3 TYPE 1 MOUNTS – (Neoprene Mount)

- A. Mason type ND or rails type RND, double deflection neoprene mounts with cast-in metal inserts for bolting to equipment and shall have a minimum static deflection of 0.35".

2.4 TYPE 2 MOUNTS – (Neoprene Pad)

- A. Mason type W pads shall be bridge bearing neoprene, $\frac{3}{4}$ " thick minimum. Pads shall be oil resistant.
- B. Both surfaces shall be rib molded for skid resistance. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang.

2.5 TYPE 3 MOUNTS – (Spring Mount)

- A. Mason type SLF, combination spring and neoprene with rib molded base. Spring type isolators shall be free standing and laterally stable without any housing, and complete with 1/2" neoprene acoustical friction pads between the baseplate and the support.
- B. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load.

2.6 TYPE 4 MOUNTS – (Restrained Spring Mount)

- A. Mason type SLR, combination spring and neoprene with rib molded base similar to type 2 above, but shall have a housing that includes vertical limit stops to prevent springs extension when weight is removed.
- B. The installed and operating heights shall be the same. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation.

2.7 TYPE S BASES – (Steel Frame)

- A. Mason type WF, structural steel bases, rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10 of the longest

dimension of the base. Beam depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of two inches. Example of call-out "3-S."

2.8 TYPE I BASES – (Steel Frame with Concrete)

- A. Mason type K, rectangular structural beam or channel concrete forms for floating foundations. Base for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.
- B. Bases shall be a minimum of 1/12 of the longest dimension of base, but not less than 6". Forms shall include minimum concrete reinforcement consisting of 1/2" bars, or angles welded in place, on 6" centers running both ways in a layer 1-1/2" above the bottom or additional steel as is required by the structural conditions. Forms shall be furnished with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts where anchor bolts fall in concrete locations. Height saving brackets shall be employed in all mounting locations to maintain a 2" clearance below the base. Example of call-out "3-I."

2.9 TYPE 5 HANGERS – (Spring)

- A. Mason type 30N, vibration hangers with a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degrees arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

2.10 TYPE 6 HANGERS – (Pre-compressed Spring)

- A. Mason type PC30N, vibration hangers similar to type 4, but precompressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. Design hangers with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load.

2.11 TYPE 7 HANGERS – (Spring with Scale)

- A. Mason type HES, a steel spring in a steel housing and include a deflection indicator scale. Hangers shall be preset at the factory for the required load. Hangers shall be capable of 130% of rated deflection, but no more than 100% of rated deflection shall be used when selecting the hanger.
- B. Submittals shall include isolator rated deflection, required deflection, and supporting calculation. Calculations shall be made by a registered mechanical or civil engineer demonstrating the structural adequacy of the hanger and that its connections to the building and the pipe are adequate for the live and dead loads encountered.

2.12 TYPE 8 HANGERS – (Spring with Eye Bolts)

- A. Mason type W30, a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. Neoprene cup to contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole size to be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs to have a minimum additional travel to solid equal to 50% of the rated deflection. Provide hangers with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps.

2.13 TYPE AG PIPE ANCHORS AND GUIDES

- A. Shall be directional acoustical pipe anchors and guides for vertical piping consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material. Vertical restraints shall prevent vertical travel in either direction. Allowable loads on the isolation materials shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.
- B. Submittals shall include supporting calculations by a registered mechanical or civil engineer indicating anchor/ guide loads and isolator selection.
- C. Pipe anchors and guides for vertical piping shall be Mason type ADA or ADAH or similar by other manufacturers listed.

2.14 TYPE T THRUST RESTRAINTS

- A. Mason type WB, horizontal thrust restraint consisting of a spring element in series, with a neoprene pad as described for type 2 mounts with the same deflection as specified for the mountings or hangers. The spring element shall be contained within a steel frame and designed so it can be present for thrust at the factory and adjusted in the field for a maximum of 1/4" movement at start and stop. Furnish thrust restraints complete with rods and angle brackets for attachment to both the equipment and ductwork or equipment and structure. Attach horizontal restraints at the centerline of thrust and symmetrically on either side of the unit.

2.15 FLEXIBLE PIPING CONNECTIONS

- A. Provide flexible connections for all piping to equipment mounted on vibration isolators and all piping connected to rotating or reciprocating equipment.
- B. Flexible connection shall be suitable for pressure, temperature and fluid involved.
- C. Minimum line length of flexible hose shall be 12" or length required to absorb 3/4" lateral movement, whichever is longer.
- D. Piping connected to a coil which is in an assembly mounted on vibration isolators is to have flexible piping connections and piping vibration hangers as specified below. Piping connected to a coil which is in an assembly where the fan is separately isolated by means of vibration isolators and duct flexible connections does not require flexible piping connectors or piping vibration hangers.
- E. Water and/or Pumped Condensate System:

1. Flexible pump connectors/expansion joints shall be of the molded twin spherical type reinforced with an external root ring between spheres. Neoprene with internal steel wire, molded within the raised face ends, for added strength. Rated for minimum pressure of 225 psi at 240°F. Flanges shall be one-piece, free-floating, class 150 galvanized plate steel type with tapped or drilled holes as required. Control Units must be furnished in unanchored applications, or as recommended by the manufacturer. Flexible connectors shall be Metraflex Doublesphere or approved equal.
 - a. Where extreme chemical resistance is required or short flange to flange dimensions are required, Flexible pump connectors/expansion joints shall be molded teflon bellows with flange connections and rubber isolated restraining bolts.
- F. Steam and Condensate System:
 1. Seamless corrugated bronze flexible hose with braided cover for 2" and smaller and seamless corrugated stainless steel flexible hose with braided cover for 2-1/2" and larger.
- G. Fuel Oil System:
 1. Seamless corrugated bronze flexible hose with braided cover.
- H. Do not provide flexible piping connectors for the following systems:
 1. Refrigerant piping
 2. Gas piping
- I. Engine Exhaust:
 1. Provide Bellows joint similar to Selkirk Metalbestos BJ.

2.16 PERFORMANCE

- A. Select all vibration isolation devices to provide minimum 95% isolation efficiency or based on the minimum static deflection and mounting criteria listed below, whichever is greater:

Equipment Type	Floor Span							
	<u>On Grade</u>		<u>20-Feet</u>		<u>30-Feet</u>		<u>40-Feet</u>	
	Type	Min. Stat. Defl. In.	Type	Min. Stat. Defl. In.	Type	Min. Stat. Defl. In.	Type	Min. Stat. Defl. In.
Refrigeration Machines								
Absorption	2	---	4	.075	4	.075	4	1.5
Centrifugal – Open	2	---	4-S	0.75	4-S	1.5	4-S	1.5

Centrifugal -Hermetic	2	---	4	0.75	4	1.5	4	1.5
Reciprocating								
to 750 rpm	2	---	4	1.5	4-S	1.5	4-S	2.5
751 rpm & over	2	---	4	0.75	4-S	1.5	4-S	2.5
Base Mounted Pumps								
Close Coupled								
through 5 hp	2-I	0.35	3-I	0.75	3-I	0.75	3-I	0.75
7 1/2 hp & over	3-I	0.75	3-I	0.75	3-I	1.5	3-I	1.5
Flexible Coupled								
through 40 hp	3-I	0.75	3-I	0.75	3-I	1.5	3-I	1.5
50 hp & over	3-I	0.75	3-I	1.5	3-I	2.5	3-I	2.5
Air Cooled Condenser	2	0.35	3	0.75	3	1.5	3	2.5
Air-Cooled Condensing Units	2	0.35	4	0.75	4	1.5	4	2.5
Fan Coil Units up to 1200 CFM	-	-	1	0.35	1	0.35	1	0.35
Air Handling Units/Blower Coils								
Suspended (Hangers)								
through 5 hp	-	-	5	1.0	5	1.0	5	1.0
7 1/2 hp & over								
through 400 rpm	-	-	5	1.5	5	1.5	5	1.5
401 rpm & over	-	-	5	1.0	5	1.0	5	1.5
Floor Mounted								
- through 5 hp	2	0.35	3	0.75	3	0.75	3	0.75
7 1/2 hp and over								
through 400 rpm	2	0.35	3-S	1.5	3-S	1.5	3-S	1.5
7 1/2 HP through 40 HP								

401 rpm & over	2	0.35	3	0.75	3	0.75	3-S	1.5
50 HP & larger								
401 rpm & over	2	0.35	3	0.75	3-S	1.5	3-S	2.5
Water Source Heat Pumps, Dehumidifiers and other unitary equipment with compressors								
Refer to Air Handling Units/Blower coils for requirements								
Utility Sets								
Suspended(Hangers)	-	-	5	.75	5	1.5	5	2.0
Floor Mounted	2	.35	3	.75	3-S	1.5	3-S	2.0
Roof Mounted	Use type 4 mount with deflection from blower minimum deflection guide up to .75" deflection. Over .75" deflection, use type 4-S mount.							
Centrifugal Blowers								
Suspended(Hangers)	Use type 5-T hangers with deflections from blower minimum deflection guide.							
Floor Mounted	Use type 3-I mount with deflection from blower minimum deflection guide.							
Tubular Centrifugal and Axial Fans								
Suspended	Use type 5 hangers with deflection from blower minimum deflection guide. Use type 4-T for deflection over 4".							
Floor mounted motor on/in fan casing	Use type 2 for .35" deflection, type 2 for .75" and type 3-S for over .75" with deflection from blower minimum deflection guide. Use type 3-S-T for deflection over 4".							
Floor mounted arrangement - 1 or any separately mounted motor	Use 2-I for .35" deflection and 3-I for .75" and over with deflection from blower minimum deflection guide.							
Cabinet Fan and Fan Heads of Air Handling Units								
Suspended	Use type 5-T supports with deflection from blower minimum							

	deflection guide.
Floor Mounted	Use type 2-T for .35" deflection, type 3-T for .75" deflections and 3-S-T for deflections over .75".
Cooling Tower	Use type 4 mounts with deflections from blower minimum deflection guide.
Piping connected to rotating or reciprocating equipment	Use flexible piping connections, and type 5 or 6 hangers for a distance of 50 feet away from the equipment.
Vertical pipe risers greater than 30 feet in height.	Use type 7 hangers at the top of the riser and type AG with pipe clamps at intermediate points.
Ductwork in mechanical equipment rooms.	Use type 8 hanger with .75" minimum deflection for all ducts with a cross sectional area of 2.0 square feet or over.

BLOWER MINIMUM DEFLECTION GUIDE				
Required Deflection (inches)				
Fan Speed (RPM)	On Grade	20' Floor Span	30' Floor Span	40' Floor Span
175-224	.35	3.5	4.5	4.5
225-299	.35	3.5	3.5	3.5
300-374	.35	2.5	2.5	3.5
375-499	.35	1.5	2.5	3.5
500 & Over	.35	.75	1.5	2.5

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate the selection of devices with the isolator and equipment manufacturer.
- B. Isolate all motor driven mechanical equipment, unless otherwise noted, from the building structure, and from the systems which they serve, to prevent equipment vibrations from being transmitted to the structure.
- C. Consider equipment weight distribution to provide uniform deflections.
- D. For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.
- E. Install vibration isolation devices as specified, as shown on the drawings and according to the manufacturer's instructions.

- F. In no case shall the installation short circuit the isolation device. Flexible piping connections are to be installed on the equipment side of shut-off valves.

3.2 PACKAGED AIR HANDLING UNITS

- A. Install type T thrust restraints at fan sections when isolated from the rest of air handling unit.

3.3 COOLING TOWER SUPPORT

- A. Provide common supporting rail above the vibration isolators for multiple cooling tower cells.

END OF SECTION 230550

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Pipe and equipment painting.
 - 4. Valve tags.

1.3 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black. Red shall be used if the equipment is on emergency power.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 1-1/2 inch.
 - 6. Minimum Letter Size: 1/2 inch Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

9. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper, tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

B. Ceiling Grid Labels for concealed equipment and valves:

1. Coordinate label style (e.g. Kroy/P-Touch tape, color coded dots, etc.) with architect and owner.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. In addition to installing labels on each major item of mechanical equipment, adhesive labels shall be located on ceiling grids directly below equipment concealed in ceilings such as reheat coils, fan coil units, air handling units, VAV boxes, fire and fire/smoke dampers and other similar equipment that requires access for service. Labels shall also be installed for all branch shutoff valves.

3.3 PIPING IDENTIFICATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09. In the absence of specific requirements to the contrary in Division 9, all exposed equipment, piping, hangers, etc., shall be painted by the Contractor. Confirm with Owner the color scheme prior to commencing with painting. Unless otherwise directed, each system shall be painted according to the following schedule:

SYSTEM	COLOR
Hot Water Supply & Return	Orange
Gas	Yellow

- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels
 - 8. At least once in each room.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

Maple Towers RAD Renovation
REW PROJECT 07425

230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for all air and water systems including, but not limited to the following:
 - 1. Air Systems.
 - 2. Hydronic Systems.
 - 3. HVAC equipment quantitative-performance settings.
 - 4. Verifying that automatic control devices are functioning properly.
 - 5. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise Criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room Criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
- J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
- K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

- L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- P. TAB: Testing, adjusting, and balancing.
- Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- R. Test: A procedure to determine quantitative performance of systems or equipment.
- S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.
- T. VFD: Variable Frequency Motor Controllers

1.4 INFORMATIONAL SUBMITTALS

- A. Certified TAB reports.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.
 - 1. The supervisor directly in charge of this testing shall have a TAB certificate and shall have not less than two years of experience in TAB work.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
 - g. Schedule for submission of 1st Draft of TAB report.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- G. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, "Air Balancing."
- H. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, "System Balancing."

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Phased TAB: The project may require startup and initial checkout to be executed in phases. This phasing will be planned and scheduled in a coordination meeting by the construction team, led by the TAB agency.

1.7 DEFICIENCIES

- A. Any deficiency in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the appropriate responsible Contractor or person.
- B. The work necessary to correct items on the deficiency list shall be performed and verified by the affected contractor or sub-contractor before the TAB agency returns to retest.
- C. The TAB agency shall return to the site to readjust systems that do not test within specified requirements.

1.8 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- D. Coordinate schedule of on-site testing efforts and TAB report submission with the Contractor and/or the Commissioning Authority (CxA). It is intended that the TAB report will be submitted prior to on-site Commissioning witness testing.

1.9 WARRANTY

- A. Special Guarantee: Provide a guarantee on national certifying agency forms stating that the national certifying agency will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when

installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6 and/or ASHRAE "Fundamentals Handbook" Duct Design Chapter. Compare this data with the design data and installed conditions.

- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible, and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine temporary strainers and verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.
- O. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- P. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- Q. Examine system pumps to ensure absence of entrained air in the suction piping.
- R. Examine equipment for installation and for properly operating safety interlocks and controls.
- S. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.

- T. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. VFD startup is complete, and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Equipment and duct access doors are securely closed.
 - i. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided
 - j. Windows and doors are installed.
 - k. Suitable access to balancing devices and equipment is provided.
 - 2. Hydronics:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
 - b. Hydronic systems are filled, clean, and free of air.
 - c. Piping is complete with terminals installed.
 - d. Water treatment is complete.
 - e. Systems are flushed, filled, and air purged.
 - f. Strainers are pulled and cleaned.
 - g. Control valves are functioning in accordance with the sequence of operation.
 - h. Shutoff and balance valves have been verified to be 100 percent open.
 - i. Isolating and balancing valves are open and control valves are operational.
 - j. Pumps are started and proper rotation is verified.
 - k. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - l. VFD startup is complete, and safeties are verified.
 - m. Suitable access to balancing devices and equipment is provided

3.3 TAB CONSTRUCTION ADMINISTRATION SERVICES

- A. Project Site Observations: During construction, the TAB agency shall observe the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems. Provide a minimum of two site observations when HVAC systems are approximately 50% and 80% complete and issue Field Reports indicating observations and noted deficiencies.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in the TAB firm's national certifying agency: AABC or NEBB; and this section.
 - 1. Comply with requirements in ASHRAE 62.1, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.
- M. Fans with Adjustable Speed Drives should be provided with the largest non-overloading sheaves available to match the "full speed" of the motor in Bypass or Hand mode of the Drive.
- N. For constant speed fans, after the system is balanced, fixed pitch sheaves shall replace the variable pitch sheaves for all motors using multiple belt drives.

- O. Outside Air. Test and adjust the outside air on applicable equipment. Outside air damper percent open shall be documented and provided to BAS contractor.
- P. Fan Static Pressure Profile. Provide a diagram of each fan and air handling unit showing the static pressure profile through each pressure drop device (coil, damper, fan, coil, dampers, etc)
- Q. Energy Efficiency Balancing Approach: At least one run-out volume damper shall be full open in efforts to provide an energy efficient balanced system.
- R. Room Airflow Tolerance. While the air outlet tolerances are +/- 10%, the Room total air balance shall also be within 10% of the scheduled room air flow.
- S. Provide duct smoke detector air differential pressure test for each duct detector in accordance with the manufacturer's instructions to insure detectors have been properly installed. Contractor shall correct any deficient installation and TAB agency shall retest.

3.6 GENERAL PROCEDURES FOR SYSTEM BALANCING WITH AIR FILTERS

- A. For supply or exhaust systems with filters, the systems shall be balanced with clean filters, then re-tested with simulated dirty filter pressure drop conditions.
- B. Dirty Filter Simulation: Use a filter area blank off plate made of cardboard or plastic to simulate the dirty filter pressure drop.
- C. Document main traversed air flows with both clean and dirty filter pressure drops.
- D. Coordinate with Contractor to replace the construction filters with new filters prior to TAB.
- E. If not provided in the Contract Documents, use the following values for dirty filter pressure drops.

Filter	Assumed Clean DP	Dirty DP
30% Pre (flat)	0.3"	0.6"
30% Pre (angled)	0.3"	0.6"
>60%	0.5"	1.0"
>90%	0.75"	1.5"
99%	0.75"	1.5"

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check expansion tank liquid level, and bladder pre-charge pressure.
 - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower (kW). Calculate the intended brake horsepower (kW) for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Balancing: Calibrated balancing valves may be utilized for constant volume pumping systems,
 1. Set calibrated balancing valves, if installed, at calculated pre-settings and test and adjust to achieve design.
 2. Systems installed with automatic flow control valves do not require terminal level hydronic balancing. For automatic flow control valves (flow limiting valves), measure and verify that the differential pressure is in the proper range for all coils.
 3. Systems installed with pressure independent control valves do not require terminal level hydronic system balancing. For pressure independent control valves flow regulator type, measure and verify that the differential pressure is in the proper range for all coils. For electronic pressure independent control valves, verify flow is in the proper range for all coils. Any individual adjustments for the pressure independent valve assembly (valve and actuator combination) for field conditions shall be performed using the pressure independent control valve manufacturer's requirements.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.
- B. Adjust the variable-flow hydronic system as follows:
 - 1. Verify that the pressure-differential sensor(s) is located as indicated.
 - 2. Determine whether there is diversity in the system.
- C. For systems with no flow diversity:
 - 1. Adjust pumps to deliver total design flow.
 - a. Measure total water flow.
 - 1) Position valves for full flow through coils.
 - 2) Measure flow by main flow meter, if installed.
 - 3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
 - b. Measure pump TDH as follows:
 - 1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - 2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - 3) Convert pressure to head and correct for differences in gauge heights.
 - 4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - 5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to

achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

- c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
2. Adjust flow-measuring devices installed in mains and branches to design water flows.
 - a. Measure flow in main and branch pipes.
 - b. Adjust main and branch balance valves for design flow.
 - c. Re-measure each main and branch after all have been adjusted.
3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
 - a. Measure flow at terminals.
 - b. Adjust each terminal to design flow.
 - c. Re-measure each terminal after it is adjusted.
 - d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
 - e. Perform temperature tests after flows have been balanced.
4. For systems with pressure-independent valves at terminals:
 - a. Measure differential pressure and verify that it is within manufacturer's specified range.
 - b. Perform temperature tests after flows have been verified.
5. For systems without pressure-independent valves or flow-measuring devices at terminals:
 - a. Measure and balance coils by either coil pressure drop or temperature method.
 - b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
6. Prior to verifying final system conditions, determine the system pressure-differential set point(s).
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:
 - a. Re-measure and confirm that total flow is within design.
 - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
 - c. Mark final settings.

D. For systems with flow diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by Architect.
3. Adjust pumps to deliver total design flow.
 - a. Measure total water flow.
 - 1) Position valves for full flow through coils.
 - 2) Measure flow by main flow meter, if installed.
 - 3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
 - b. Measure pump TDH as follows:
 - 1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - 2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - 3) Convert pressure to head and correct for differences in gauge heights.
 - 4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - 5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
 - c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
4. Adjust flow-measuring devices installed in mains and branches to design water flows.
 - a. Measure flow in main and branch pipes.
 - b. Adjust main and branch balance valves for design flow.
 - c. Re-measure each main and branch after all have been adjusted.
5. Adjust flow-measuring devices installed at terminals for each space to design water flows.
 - a. Measure flow at terminals.
 - b. Adjust each terminal to design flow.
 - c. Re-measure each terminal after it is adjusted.
 - d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
 - e. Perform temperature tests after flows have been balanced.
6. For systems with pressure-independent valves at terminals:

- a. Measure differential pressure, and verify that it is within manufacturer's specified range.
 - b. Perform temperature tests after flows have been verified.
7. For systems without pressure-independent valves or flow-measuring devices at terminals:
 - a. Measure and balance coils by either coil pressure drop or temperature method.
 - b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system pressure-differential set point(s).
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:
 - a. Re-measure and confirm that total water flow is within design.
 - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
 - c. Mark final settings

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

- A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR PUMP BALANCING

- A. Constant Speed Pumps. Coordinate constant speed pump impeller trimming so that the pump will provide 110% of design flow with the balancing valve at the pump wide open. After trimming, the balancing valve shall be adjusted to provide the designed flow rate. This will leave 10% spare safety capacity. The pump specification requires a spare impeller for all pumps. TAB technician to provide impeller trimming diameter requirements to the mechanical contractor. The spare impeller shall be shaved to proper dimensions, then it shall replace the original impeller, and the original full-size impeller shall become the spare.
- B. Variable Speed Pumps.
 1. Impellers. Pumps on adjustable speed drives should be provided with the largest non-overloading impellers available; all balancing should be done via the adjustable speed drives.

2. DP Setpoint. Set pump differential pressure control tracking setpoint to maintain flow at design diversity established. Record in the TAB report the pressure requirement at the differential pressure sensor. The expected range of the DP setpoint is 5 psi to 10 psi at the most hydraulically remote piece of equipment. If static pressure reset strategy is used, record the average plant DP setpoint.
3. Manual Valves at Devices. For manual balancing valves in the variable flow systems, manually set the overall system to 25% design flow by closing control or manual valves to coils. Retest 20% of the coils closest to the pump and readjust the manual balance valves to achieve design flow with full flow through that coil. The readjusted setting shall be the final setting for those coils. This approach ensures design flow through the device at low system flow, and assumes a local overflow situation at higher system flows.
4. Full Flow Test. Coordinate with BAS to override all water valves to full open position. Ensure the pump adjustable speed drive speed is less than 100% and the DP setpoint is maintained. If this test fails, then rebalancing will be required.
5. Record recommended differential pressure setpoint value, and associated pump adjustable speed drive speeds at recommended value.

3.12 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP (0.37 kW) and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer, model, and serial numbers.
 2. Motor horsepower (kW) rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by VFD's: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass (if applicable) for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.13 PROCEDURES FOR BOILERS

- A. Hydronic Boilers:
 1. Measure and record entering- and leaving-water temperatures.
 2. Measure and record water flow.
 3. Measure and record pressure drop.
 4. Measure and Record relief valve(s) pressure setting.
 5. Capacity: Calculate in Btu/h of heating output.
 6. Fuel Consumption: If boiler fuel supply is equipped with flow meter, measure and record consumption.

7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data

3.14 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. For Air Handling Units: Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied. This can be accomplished thru the Building Automation System.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.15 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.16 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Supply, Return, Outside Air and Exhaust Fans and Equipment with Fans: Plus 10 percent to minus 10 percent. This includes duct distribution loss. For systems where minimum air change or other minimum airflows are required, tolerance shall be 0 to plus 10%.
 2. Air Outlets and Inlets: Plus 10 percent to minus 10 percent, as long as the overall room is balanced properly and room minimum code required total air changes per hour are maintained.
 - a. Refer to Scheduled Load Manager on the drawings for minimum total air change code or Owner requirements.
 3. Heating-Water Flow Rate: Plus 10 percent to minus 10 percent.

4. Generation Equipment (chillers, boilers, etc) should be balanced as close as possible to the accuracy of the measuring equipment.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.17 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.18 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data
- B. Final Report Contents: In addition to certified field report data, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.

7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils if applicable.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. General Report requirements: Include the following in reports for all equipment for comparison for recorded values:
1. Current BAS sensor readings for Outdoor airflow, CHW flowmeter, static pressure sensors, etc.
- F. Air-Handling Unit, Fan Coil Unit and Blower Coil Unit Test Reports: For units with coils, include the following:
1. Unit Data: Include the following:
 - a. Unit identification.

- b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
- 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower (KW) and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Outside airflow in cfm.
 - g. Outside-air damper position.
 - h. Return-air damper position.
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btuh.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower (kW) and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.

- n. Sheave dimensions, center-to-center, and amount of adjustments in inches.
- 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btuh.
 - i. High-fire fuel input in Btuh.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btuh.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btuh.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower (KW) and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - g. Number of belts, make, and size.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.

- e. Suction static pressure in inches wg.

I. Boiler Test Reports:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Service.
- d. Make and type.
- e. Model and serial numbers.
- f. Fuel type and input in Btuh.
- g. Number of passes.
- h. Ignition type.
- i. Burner-control types.
- j. Voltage at each connection.
- k. Amperage for each phase.

2. Test Data (Indicated and Actual Values):

- a. Operating pressure in psig.
- b. Operating temperature in deg F.
- c. Entering-water temperature in deg F.
- d. Leaving-water temperature in deg F.
- e. Number of safety valves and sizes in NPS.
- f. Safety valve settings in psig.
- g. High-limit setting in psig.
- h. Operating-control setting.
- i. High-fire set point.
- j. Low-fire set point.
- k. Voltage at each connection.
- l. Amperage for each phase.
- m. Draft fan voltage at each connection.
- n. Draft fan amperage for each phase.
- o. Manifold pressure in psig.

J. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.19 GAUGE AND SENSOR ACCURACY VALIDATION

- A. The accuracy of the project's installed gauges, thermometers and sensors shall be validated by the TAB Contractor. The TAB Contractor shall use calibrated gauges and thermometers and compare the values against the contractor installed gauges, thermometers and sensors.

1. Pressure gauges and BAS sensors – Water Systems

- a. The installed pressure gauges shall be within 2 psi (14 kPa) or 5% of the TAB contractors calibrated gauge at the normal system operating pressure.
- b. TAB shall notify the Mechanical Contractor of any gauge deficiency, for the gauge to be recalibrated or replaced.
- c. Replaced gauges shall be verified for accuracy by TAB.

2. Thermometers and BAS sensors – Water Systems

- a. The installed thermometers and sensors shall be within the following tolerances of the TAB contractor's calibrated temperature range at normal system operating temperatures:
 - 1) Hot Water: 2.0°F (1.0°C)
- b. TAB shall work with the BAS contractor to calibrate sensors.
- c. TAB shall notify appropriate responsible contractor of gauge or sensor deficiency for the above to be re-calibrated or replaced.
- d. Replaced gauges shall be verified for accuracy by TAB.

3. Flow Meters – Water Systems

- a. After the flow meter has been set up and calibrated by the manufacturer's representative, the TAB contractor shall validate the flow by using ultrasonic flow measuring equipment. The flow meters shall be within 5% flow of the TAB contractor's calibrated equipment measurement.
- b. TAB shall notify appropriate responsible contractor of the flow meter accuracy deficiency for the flow meter to be re-calibrated or replaced.

4. Pressure Gauges and BAS Sensors – Air Systems

- a. The installed pressure gauges and BAS pressure sensors shall be within 10% of the TAB contractor's calibrated gauge at the normal operating pressures.
- b. TAB shall notify the responsible contractor of gauge or sensor deficiency for the above to be re-calibrated or replaced.
- c. Replaced gauges shall be verified for accuracy by TAB.
- d. The following are the tolerances for various pressure gauges and sensors:
 - 1) Filters: +/- 10%
 - 2) Duct: +/- 10%
 - 3) Space: +/- 0.01"
 - 4) Isolation Room: +/- 0.001" wg

5. Thermometers and BAS Sensors – Air Systems

- a. The installed duct thermometers shall be within 1F of the TAB contractors calibrated gauge.
- b. Duct or air handling unit mounted BAS sensors shall be within 1F of TAB contractor's calibrated gauge. This includes OA, MA, coil, leaving air, and return air sensors.
- c. TAB shall notify responsible contractor of accuracy deficiency, for the device to be recalibrated or replaced.

6. Air Flow Measuring Stations (AFMS)

- a. The TAB Contractor shall validate the accuracy of air flow measuring stations by taking traverse readings. The accuracy shall be within 5%.
- b. TAB shall notify responsible contractor of accuracy deficiency for the device to be recalibrated or replaced.

3.20 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Measure space pressure of at least 10 percent of locations.
 - e. Verify that balancing devices are marked with final balance position.
 - f. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner or Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner or Architect.
3. Owner or Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

C. Authority Having Jurisdiction Inspection

1. Attend inspection by AHJ. A completed and approved certified copy of the TAB report shall be available at the project site at the AHJ inspection. This includes AHCA and OSHPD inspections.

3.21 DEFICIENCY RESOLUTION

- A. As testing progresses and a deficiency is identified, the TAB contractor shall coordinate with the Contractors to identify the deficiency for a timely resolution of the deficiency.
- B. The TAB contractor shall include in their base bid, the initial test adjust balance, plus returning to the site for two additional visits to retest systems that do not test within specification requirements. Any additional testing requirements will fall under requirements listed under Cost of Retesting.
- C. Cost of Retesting
 1. The cost for any additional testing beyond the requirements in the paragraph above shall be borne by the installing Contractors, if they are responsible for the deficiency. If they are not responsible, then reasonable costs for retesting shall be negotiated with the Contractor.
 2. The time for the Architect/Engineer to direct any retesting required because a specific system report to have been successfully completed, but determined during testing to be faulty, will be back-charged to the Contractor, who may choose to recover costs from the party responsible for stating the system was complete and ready for testing.
- D. Failure Due to Manufacturer Defect: If 10%, or three (whichever is greater), of identical pieces (size does not constitute a difference) of equipment fails to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance, then all identical units may be considered unacceptable by the TAB agency or the Architect/Engineer. In such case, the Contractor shall provide the Owner with the following:
 1. Within one week of notification from the TAB agency, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the Architect/Engineer within two weeks of the original notice.
 2. Within two weeks of the original notification, the Contractor or manufacturer's representative shall provide a signed and dated written explanation of the problem,

cause of failures, etc., and proposed solutions which shall include full equipment submittals. The propose solutions shall not significantly exceed the specification requirements of the original installation.

3. The Architect/Engineer will determine whether a replacement of all identical units or a repair is acceptable.
4. The proposed solution will be installed by the Contractor, and tested for up to one week, upon which the Architect/Engineer will decide whether to accept the solution.
5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

3.22 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, then the TAB contractor shall return to perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.
 1. Air handler coil performance test shall be recorded during the opposite season.
 2. To verify system calibration, control and operation, test and record 25% of the previously recorded room temperatures (dry bulb and wet bulb). Measurements shall be made near each room sensor or thermostat location in each separate controlled zone. The resulting temperature data shall be included in a revised report with associated thermostat or control setpoint during the tests. Outside temperature and humidity conditions shall also be recorded during the testing periods.
 3. Areas of verification include: economizer airflows, building or space pressurization, coil leaving air temperature accuracy.

3.23 SPACE TEMPERATURE AND HUMIDITY VERIFICATION

- A. For hotel guestrooms, apartment units and condo units, provide one week of temperature and humidity data for a guestroom, apartment or condo unit on each floor. This can be achieved through the Building Automation System or by the use of data loggers.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:

- a. Calcium silicate.
 - b. Cellular glass.
 - c. Flexible elastomeric.
 - d. Mineral fiber.

- 2. Fire-rated insulation systems.
 - 3. Insulating cements.
 - 4. Adhesives.
 - 5. Coatings/Mastics.
 - 6. Lagging adhesives/coatings.
 - 7. Sealants.
 - 8. Factory-applied jackets.
 - 9. Field-applied fabric-reinforcing mesh.
 - 10. Field-applied cloths.
 - 11. Field-applied jackets.
 - 12. Tapes.

- B. Related Sections:

- 1. Division 21 Section "Fire-Suppression Systems Insulation."
 - 2. Division 22 Section "Plumbing Insulation."
 - 3. Division 23 Section "Metal Ducts" for duct liners.
 - 4. Division 23 Section "BIM Coordination Drawings".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program and are qualified in the installation of insulation and insulation products indicated and per insulation scheduled.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Industrial Insulation Group (The); Thermo-12 Gold.
 - b. Pabco Super Caltemp
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Owens Corning Corporation; Foamglas One.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 7. Prefabricate insulation for valves, elbows, tees, flanges and other fittings.
- H. Flexible Elastomeric: Closed-cell expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.
 - b. Armacell LLC.
 - c. K-Flex
 2. Flame spread and smoke developed index of 25/50 per ASTM E84.
 3. Unslit or slit type with self- sealing factory installed tape with overlapping longitudinal seam seal as required to suit the installation.
 4. Where scheduled for piping systems where service temperatures exceeds 220 Deg F, insulation shall be EPDM rubber based with service temperature rating of 255 Deg F minimum.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB with factory applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.

- b. Johns Manville; MicroFlex.
- c. Knauf Insulation; Pipe and Tank Insulation.
- d. Manson Insulation Inc.; AK Flex.
- e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Thermal Ceramics; FireMaster Duct Wrap.
 - d. 3M; Fire Barrier Wrap Products.
 - e. Unifrax Corporation; FyreWrap

2.3 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, H. B. Fuller Construction Products; CP-97.
 - b. Foster Products, H. B. Fuller Construction Products; 81-27.

- C. Cellular-Glass, Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, H. B. Fuller Construction Products; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Construction Products; 81-33.
- D. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I/
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Products, H. B. Fuller Construction Products; 85-75
 - b. K-Flex, 373
- E. Mineral-Fiber Adhesive: Comply with ASTM C 916 Type I/II.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, H. B. Fuller Construction Products; CP-127/CP-82.
 - b. Foster Products, H. B. Fuller Construction Products; 85-60/85-20.
- F. ASJ Adhesive, and FSK Jacket Adhesive: Comply with ASTM C 916 Type I/II for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, H. B. Fuller Construction Products; CP-127/CP-82.
 - b. Foster Products Corporation, H. B. Fuller Construction Products; 85-60/85-20.
- G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 COATINGS/MASTICS

- A. Vapor-Barrier Coating: Mold Resistant, water based; suitable for indoor and outdoor use on below ambient services. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II and must be QPL listed
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Products, H. B. Fuller Construction Products; 30-80 AF.
 - 2. Must comply with ASTM D 5590 with 0 growth rating.
 - 3. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 4. Service Temperature Range: Minus 20 to plus 180 deg F.
- B. Vapor-Barrier Coating: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; H.B. Fuller Construction Products; Encacel V/VI.
 - b. Foster Products; H.B. Fuller Construction Products; 60-95/60-96.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; H.B. Fuller Construction Products; CP-10/CP-11.
 - b. Foster Products; H.B. Fuller Construction Products; 46-50.
 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White

2.6 LAGGING ADHESIVES/COATINGS

- A. Description: Mold resistant. Shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, H. B. Fuller Construction Products; CP-137 AF.
 - b. Foster Products, H. B. Fuller Construction Products; 30-36 AF.
 2. Must comply with ASTM D 5590 with 0 growth rating.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
 4. Service Temperature Range: Minus 50 to plus 180 deg F.

2.7 SEALANTS

- A. Joint Sealants:
1. Products: Subject to compliance with requirements, provide one of the following
 - a. Childers Products, H. B. Fuller Construction Products; CP-76/CP-70.
 - b. Foster Products, H. B. Fuller Construction Products; 30-45/95-50.
 - c. Pittsburgh Corning Pittseal 444N or 727

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, sealant.
4. Service Temperature Range: Minus 100 to plus 200 deg F.
5. Color: White, gray, tan, or aluminum

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, H. B. Fuller Construction Products; CP-76/CP-70.
 - b. Foster Products, H. B. Fuller Construction Products; 95-44/30-45.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Gray or Aluminum

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following :
 - a. Childers Products, H. B. Fuller Construction Products; CP-76/CP-70.
 - b. Foster Products, H.B. Fuller Construction Products; 95-44/30-45.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Gray or Aluminum

2.8 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color as selected by Architect.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor or Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor and outdoor applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

D. Exterior Weather Cladding

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Polyguard Alumaguard 60
 - b. VentureClad 1579CW
2. Aluminum Film Rubberized Asphalt Jacket (60 Mil) Aluminum faced laminate with rubberized asphalt backing self sealing product or Fiber reinforced Self-Adhesive Jacket

(13-ply thick) laminated, flexible, self-adhering protective jacketing, vapor barrier and weather proofing membrane.

- a. Roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. For use on duct and pipe
 - d. UV resistant.
 - e. Built in adhesive. Provide additional adhesive for cold weather installing applications as required.
 - f. Alumaguard Lite or VentureClad 1577 are not equivalent products.
- E. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pittsburgh Corning Corporation; Pittwrap.
 - b. Polyguard; Insulwrap No Torch 125.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
 2. Thickness: 11.5 mils.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Width: 2 inches.
 2. Thickness: 6 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Install joint sealant for all longitudinal and butt joints.
- K. Insulation is required for all systems and equipment operating below 70 F and above 105 F.
- L. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- M. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- N. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with fab and mastic to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- O. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- P. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- Q. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- R. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.

- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated):
Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 - 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 - 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
 - 1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 - 2. Fabricate boxes from aluminum or stainless steel, at least 0.050 inch thick.

3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves and strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 5. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 7. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 8. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.7 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Boiler Breechings, Ducts, Straight Pipes, and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.8 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

3.9 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- #### A.
- Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Blanket or Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers insulation surface. Cover exposed pins and washers with fab and mastic.
 4. For all ducts and plenums, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. All joints, seams and punctures shall be sealed with fabric and mastic. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 6 inches o.c. Cover all joints, seams and punctures with minimum 3" wide glass cloth cloth fabric set in mastic. After first coat is dry, apply second coat of mastic.

7. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
8. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.13 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum or stainless-steel jackets.

3.14 DUCT INSULATION SCHEDULE, GENERAL

- A. Ductwork insulation includes all apparatus casings such as air terminal devices, duct heating coils, filters, mixing chambers, sound attenuators, etc., which shall be insulated in accordance with applicable ductwork insulation specifications.
- B. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply, return, and outdoor air.
 - 2. Indoor, exposed supply, return, and outdoor air.
 - 3. Indoor, Type I, commercial, kitchen hood exhaust.
 - 4. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 5. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 6. Flexible connectors.
 - 7. Vibration-control devices.
- C. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Double wall ducts.
 - 4. Factory-insulated flexible ducts.
 - 5. Factory-insulated plenums and casings.
 - 6. Factory-insulated access panels and doors.

3.15 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Unconditioned spaces shall be considered to be outdoors.
- B. Concealed supply-air, return-air, and outside-air duct insulation shall be the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.

3.16 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated unless noted otherwise.
- C. Hot water systems.
 - 1. Heat-exchanger (water-to-water for heating service) insulation shall be one of the following:
 - a. Calcium Silicate: 3 inches thick.
 - b. Cellular Glass: 3 inches thick.
 - c. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

- d. Mineral-Fiber Pipe and Tank: 2 inches thick.
- 2. Heating-hot-water expansion/compression tank insulation shall be one of the following:
 - a. Calcium Silicate: 3 inches thick.
 - b. Cellular Glass: 3 inches thick.
 - c. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
 - d. Mineral-Fiber Pipe and Tank: 2 inches thick.
- 3. Heating-hot-water air-separator insulation shall be one of the following:
 - a. Calcium Silicate: 3 inches thick.
 - b. Cellular Glass: 3 inches thick.
 - c. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
 - d. Mineral-Fiber Pipe and Tank: 2 inches thick.
- 4. Thermal storage (Buffer) tank insulation shall be one of the following:
 - a. Calcium Silicate: 3 inches thick.
 - b. Cellular Glass: 3 inches thick.
 - c. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.
 - d. Mineral-Fiber Pipe and Tank: 2 inches thick

3.17 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
- C. For piping exposed to outdoor air, increase the thickness shown in the schedule below by ½" (in.).
- D. PIPING INSULATION SCHEDULE
- E. Heating-Hot-Water Supply and Return,:
 - 1. Pipe size NPS 1 1/4 and smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1 1/2 inches. thick
 - b. Mineral-Fiber, Preformed Pipe: 1 1/2 inches thick. Use limited to interior applications only.
 - 2. Pipe size larger than NPS 1 1/4: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches. thick

- b. Mineral-Fiber, Preformed Pipe: 2 inches thick. Use limited to interior applications only.
- F. Ductless Split System and Split DX system Refrigerant Suction and Hot-Gas Bypass Piping (If Used):
 - 1. Flexible Elastomeric: 1 inch thick.
- G. Ductless Split System and Split DX system Refrigerant Liquid Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 - 1. None.
- D. Ducts and Plenums, Exposed:
 - 1. None.
- E. Equipment, Concealed:
 - 1. None.
- F. Equipment, Exposed:
 - 1. None.
- G. Piping, Concealed:
 - 1. None.
- H. Piping, Exposed:
 - 1. Within 6 feet A.F.F. PVC: 30 mils thick.

END OF SECTION 230700

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.3 DESCRIPTION OF SYSTEM

- A. Furnish and install a complete Building Automation System, BAS, utilizing Direct Digital Controls, DDC, in accordance with drawings, specifications and intent of the design.
- B. The new DDC BAS components shall be tied into the owner's existing BAS network if available. The expanded BAS system shall be compatible and by the same manufacturer of the existing system and shall be complete in all respects. All DDC parameters shall be available through the BAS network and existing operator workstation. System access is provided by the operator workstation, network terminal and remote access via modem by manufacturer. Provide graphics for the new systems and equipment. The new control system shall be monitored and controlled via WebView online system.
- C. The BAS shall comply with the latest ANSI/ASHRAE Standard 135, BACnet. This system is to control all mechanical equipment, including all unitary equipment such as VAV boxes, heat pumps, fan-coils, AC units, etc. and all air handlers, boilers, chillers, and any other listed equipment using native BACnet-compliant components.
- D. All components not specifically indicated or specified (including relays and switches), but necessary to make the system function within the intent of the specification, are to be included.
- E. Size all control apparatus to properly supply and/or operate and control the apparatus served.
- F. All electrical products shall be listed and labeled by UL and comply with NEMA Standards.
- G. All electrical work required as an integral part of the Building Automation System is the responsibility of the control contractor, including but not limited to control wiring, interlock wiring, electrical wiring, smoke dampers, and associated control power wiring including power to control panels. This is in addition to power indicated to control panels for air handling units and other pieces of mechanical equipment. All control wiring and conduit shall comply with NEC and Division 26 Specifications.
- H. All wiring shall be installed in conduit within walls or inaccessible ceiling spaces. MC Cable is acceptable for inaccessible ceiling spaces. Wiring/cablng can be run exposed on j-hooks above accessible ceiling areas. Provide plenum rated cabling as required.

- I. All computing devices, as defined in FCC Rules and Regulations, Part 15, shall be verified to comply with the requirements for Class A computing devices and labeled as set forth in FCC Rules and Regulations, Part 15.
- J. Field Enclosures: Enclosures shall conform to the requirements of the NEMA types. NEMA 4X shall be used outdoors near cooling towers and within 3 miles of the ocean. Finish color shall be of the manufacturer's standard, unless otherwise stated. Damaged surfaces shall be repaired and/or refinished to its original condition.
- K. Provide remote communication to the BAS system.
- L. Any control devices subject to corrosion, such as in fume hood exhaust duct or in pool or in seacoast atmosphere, shall be provided with appropriate corrosion protection.

1.4 DEFINITIONS

- A. ANALOG: A continuously varying signal value, such as current, flow, pressure, or temperature.
- B. BAS: Building Automation System
- C. BINARY: Two-state signal where a high signal level represents ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.
- D. DDC: Direct digital control.
- E. I/O: Input/output.
- F. MS/TP: Master slave/token passing.
- G. PID: Proportional plus integral plus derivative.
- H. RTD: Resistance temperature detector.

1.5 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
 - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
 - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
 - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
 - 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows unless noted otherwise:
 - a. Water Temperature: Plus or minus 1 deg F.
 - b. Water Flow: Plus or minus 2 percent of reading.

- c. Water Pressure: Plus or minus 2 percent of full scale.
- d. Space Temperature: Plus or minus 1 deg F.
- e. Ducted Air Temperature: Plus or minus 1 deg F.
- f. Outside Air Temperature: Plus or minus 2 deg F.
- g. Dew Point Temperature: Plus or minus 3 deg F.
- h. Temperature Differential: Plus or minus 0.25 deg F.
- i. Relative Humidity: Plus or minus 5 percent.
- j. Airflow (Measuring Stations): Plus or minus 3 % to 10% of reading, refer to Part 2 for specific requirements.
- k. Airflow (Terminal): Plus or minus 10 percent of full scale.
- l. Air Pressure (Critical Space): Plus or minus 10% of reading.
- m. Air Pressure (Building): Plus or minus 1% of full scale.
- n. Air Pressure (Ducts): Plus or minus 1% of full scale.
- o. Carbon Monoxide: Plus or minus 5 percent of reading.
- p. Carbon Dioxide: Plus or minus 50 ppm.
- q. Electrical: Plus or minus 5 percent of reading.

1.6 SEQUENCE OF OPERATION

- A. Refer to drawings.

1.7 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. DDC System Hardware: Bill of materials of equipment indicating manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Schedule of dampers including size, leakage, and flow characteristics.
 - 6. Schedule of valves including flow characteristics.

7. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
8. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
9. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
 1. Interconnection wiring diagrams with identified and numbered system components and devices.
 2. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 4. Calibration records and list of set points.
 5. The Building Automation System contractor shall furnish to the Engineer, upon completion of the work, but before final acceptance of the system, a pdf copy of instructions covering complete maintenance and operation of the system and a complete set of as-built drawings of control diagrams.
 6. Maintenance instructions shall include manufacturer's literature on all system equipment components. All maintenance instructions shall be explicit concerning time intervals for all servicing and preventative maintenance, types and grades of oil and/or grease, packing materials, normal and abnormal clearance, methods of equipment adjustments, and a complete description of replacement parts and materials for wearing items.
 7. Upon completion of the installation, the control contractor shall submit to the Owner a proposal to provide the necessary programmed maintenance to keep the system in proper working condition. This proposal shall fully describe the maintenance cost of this work during the guarantee period as well as for subsequent years thereafter.
 8. List of spare parts for each type of control device.
 9. Contact names and 24 hour telephone numbers for service..
 10. A list and documentation of all custom software created.

11. ACAD files for the drawings, BAS software files, database files and files of all color graphic screens created for the project.
12. Guarantees and warranty documents for all equipment and systems.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On disc, complete with data files and graphic screens.
3. Device address list.
4. Software license for DDC workstations and control systems.

C. Training Manuals: The contractor shall provide a course outline and training manuals for all training classes for Engineer's and Commissioning Authority if one exists review. The Engineer or Commissioning Authority may modify training materials to meet the needs of the Owner. Review and approval by the Engineer shall be completed prior to substantial completion and the first training class

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: The control system shall be installed by competent control technicians under the direct employment of local branch office of the manufacturer of the control equipment. All control equipment shall be the product of one manufacturer. The control contractor shall have local maintenance capabilities available within a 100 mile radius of the project site. The control contractor must have installed Direct Digital Controls of the type and manufacturer specified for at least five years prior to commencing this project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.10 GUARANTEE/MAINTENANCE

- A. Guarantee the BAS to maintain the temperature in rooms within one degree of the setting and further guarantee all work, materials equipment, and controls against defects in workmanship and material and provide service for a period of one (1) year from date of final acceptance.
- B. Replace any defective workmanship or material developing within that time as soon as possible at no charge to the Owner.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. Field-Installed Components: Shall be protected per Division 23 Section "Common Work Results for HVAC"

1.12 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alerton Inc.
 - 2. Automated Logic Corporation.
 - 3. Delta Controls Inc.
 - 4. Distech Controls.
 - 5. Honeywell International Inc.
 - 6. Invensys Building Systems.
 - 7. Johnson Controls, Inc.
 - 8. Reliable Controls.
 - 9. Siemens Building Technologies, Inc.
 - 10. TCS/Basys Controls.
 - 11. Trane
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, power supplies, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment and programmed to control mechanical systems. Control system shall be on a dedicated network. The use of the building IT network may be utilized for communication if owner approval is received. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- C. Third Party Manufacturers: Control components provided by other manufactures are subject to compliance with performance requirements specified.

2.2 DDC EQUIPMENT

- A. Operator Workstation: One Desktop PC with associated inkjet printer, capable of operating latest version of Microsoft Windows (64 Bit) with the following minimum hardware requirements: Intel quad-core processor, 4 GB RAM, 500 GB hard drive, 1 GB graphics card, DVD-ROM burner, Ethernet and wireless internet adapter, and 4 USB ports. In addition to internal hardware requirements, provide, optical mouse and 22 inch flat panel LCD monitor, and 2 kVa Uninterruptible Power Supply.
- B. Application Software:
 - a. I/O capability from operator station.

- b. System security for each operator via software password and access levels.
- c. Automatic system diagnostics; monitor system and report failures.
- d. Database creation and support.
- e. Automatic and manual database save and restore.
- f. Dynamic color graphic displays with up to 10 screen displays at once.
- g. Custom graphics generation and graphics library of HVAC equipment and symbols.
- h. Alarm processing, messages, and reactions.
- i. Trend logs retrievable in spreadsheets and database programs.
- j. Alarm and event processing.
- k. Object and property status and control.
- l. Automatic restart of field equipment on restoration of power.
- m. Data collection, reports, and logs. Include standard reports for the following:
 - 1) Current values of all objects.
 - 2) Current alarm summary.
 - 3) Disabled objects.
 - 4) Alarm lockout objects.
 - 5) Logs.
- n. Custom report development.
- o. Utility and weather reports.
- p. ASHRAE Guideline 3 report for chillers.
- q. Workstation application editors for controllers and schedules.
- r. Maintenance management.

C. Custom Application Software:

- a. English language oriented.
- b. Full-screen character editor/programming environment.
- c. Allow development of independently executing program modules with debugging/simulation capability.
- d. Support conditional statements.
- e. Support floating-point arithmetic with mathematic functions.
- f. Contains predefined time variables.

D. Control Units: Modular, comprising of processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

- 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
- 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.

- d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 - 3. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - d. Remote communications.
 - e. Maintenance management.
 - f. Units of Measure: Inch-pound and SI (metric).
 - 4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- E. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 - 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- F. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
 - 1. Binary Inputs: Allow monitoring of on-off signals without external power.
 - 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 - 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 - 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.

5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

2.3 WEB ACCESS

- A. DDC system shall be Web compatible.

1. Web-Compatible Access to DDC System:

- a. Workstation and server shall perform overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation.
- b. DDC system shall support Web browser access to building data. Operator using a standard Web browser shall be able to access control graphics and change adjustable set points.
- c. Web access shall be password protected.

2.4 DDC SYSTEM WIRELESS NETWORKS

- A. In lieu of wired control network, wireless networks are acceptable. Wireless control system shall meet all of the provisions of this specification.
- B. Use Zigbee or an open industry standard and technology used by multiple BAS system manufacturers technology to create a wireless mesh network to provide wireless connectivity for network devices at multiple system levels including communications from programmable controllers and to temperature sensors and from network controllers to programmable controllers.
- C. Installer shall design wireless networks to comply with BAS system performance requirements indicated. Wireless network devices shall co-exist on same network with hardwired devices.
- D. Hardwired controllers shall be capable of retrofit to wireless devices with no special software.

2.5 POWER SUPPLY

- A. Power Supplies: UL listed transformers with Class 2 current-limiting type or overcurrent protection for AC or DC power for each DDC controller and module. Limit connected loads to 80 percent of rated capacity.
1. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
- a. Output ripple of 5.0 mV maximum peak to peak.
 - b. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.

- c. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- B. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
 - 1. Minimum dielectric strength of 1000 V.
 - 2. Maximum response time of 10 nanoseconds.
 - 3. Minimum transverse-mode noise attenuation of 65 dB.
 - 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.6 UNINTERRUPTIBLE POWER SUPPLY SYSTEM

- A. Provide small plug-in UPS for all BAS control system field panels. The UPS shall be sized for application plus 20% spare capacity. If the UPS device will not fit inside a BAS control panel, then provide an adjacent cabinet for the UPS. Control panels shall be equipped with a receptacle for UPS connection to utility power. Provide one UPS for each systems level control panel and for the chiller plant control panel.
- B. The capacity of the UPS shall be sized for no less than one minute. The purpose of the UPS shall be to maintain the BAS network traffic and prevent a complete BAS system restart in the event of a short utility power disruption.
- C. All equipment connected to the BAS shall include automatic restarting upon loss of utility power or network communication for any reason.

2.7 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 - 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 - 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms.
 - 3. Enclosure: In conditioned spaced, dustproof rated for operation at 32 to 120 deg F. In outdoor applications or in wet ambient conditions, waterproof rated for operation at minus 10 to 150 deg F.

2.8 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.

- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

- 1. Single controllers can be integral with control motor if provided with accessible control

2.9 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

- B. Temperature Sensors: RTDs and Transmitters.

- 1. Accuracy: Plus or minus 0.2 percent at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 - 4. Averaging Elements in Ducts and Air Handling Units: 24 feet long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required. Provide averaging sensors for all mixed air applications.
 - 5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 - 6. Room Sensor Cover Construction: Manufacturer's standard display and covers.
 - a. Set-Point Adjustment: Concealed for public areas.
 - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

- C. Humidity Sensors: Bulk polymer sensor element.

- 1. Accuracy: 2 percent full range with linear output.
 - 2. Room Sensor Range: 20 to 80 percent relative humidity.
 - 3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - 4. Duct Sensor: 0 to 100 percent relative humidity range with element guard and mounting plate.
 - 5. Outside-Air Sensor: 0 to 100 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.

- D. Pressure Transmitters/Transducers:

- 1. Manufacturers:
 - a. BEC Controls Corporation.
 - b. Dwyer.
 - c. General Eastern Instruments.
 - d. MAMAC Systems, Inc.
 - e. ONICON Incorporated.

- f. Senva.
 - g. Veris.
 - h. Vaisala.
 - i. or equal standard products of the BAS manufacturer.
- 2. Water Digital Pressure Gage: Stainless-steel diaphragm construction, one piece construction electronic pressure gage with analog output suitable for service. Suitable range for expected input with pressure range of +/- 0 to 50 psig, +/- 0 to 100 psig or +/- 0 to 250 psig. Transmitter shall have an integral LCD display. Make Veris or equal.
 - a. Accuracy: 1 percent of full scale at any range with repeatability of 0.5 percent.
 - b. Output: linear field selectable of 0-10V or 4 to 20 mA.
 - c. Operating Pressure: minimum 150-psig
 - d. Proof Pressure: 2 times full scale range.
 - e. Burst Pressure: 5 times full scale range.
- 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service. Suitable range for expected input. Provide transmitter suitable for application with pressure range of +/- 0 to 50 psig, +/- 0 to 100 psig or +/- 0 to 250 psig and automatic zeroing. Transducer shall have four switch selectable sub-ranges within each option. Transmitter shall be provided with the pressure sensors. Provide and install with Bypass Valve Manifold assembly equivalent to Veris AA14A. Veris PW2LX or equal.
 - a. Accuracy: 1 percent of full scale selected sub-range, 2 percent full scale at minimum selected sub-range with repeatability of 0.5 percent.
 - b. Output: linear field selectable of 0-10V or 4 to 20 mA.
 - c. Operating Pressure: minimum 150-psig
 - d. Proof Pressure: 2 times full scale range.
 - e. Burst Pressure: 5 times full scale range
 - f. Remote pump differential pressure Range: +/- 50 psi (345-kPa).
 - g. Sensor shall have digital display.
- 4. Differential-Pressure Switch (Air or Water): Adjustable, snap acting, with pilot-duty rating and with suitable scale range and differential. Provide switch with auxiliary contacts for remote notification of BAS.
- 5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.10 STATUS SENSORS

- A. Current Sensors - Status Inputs for Fans, Pumps, and Electric Motors: Comply with ISA 50.00.01, current-sensing split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current. The smart current sensor shall be compatible with the 4-20 MA signal for the DDC panel. The current sensor shall provide a resistance change proportional to the input signal. Veris Hawkeye 921 or approved equal.
- B. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

- C. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

2.11 FLOWMETERS

A. Turbine Flowmeters:

- 1. Manufacturers:
 - a. ONICON Incorporated
 - b. ABB; Instrumentation and Analytical.
 - c. Data Industrial Corp.
 - d. EMCO Flow Systems; a division of Spirax Sarco, Inc.
 - e. ERDCO Engineering Corp.
 - f. Liquid Controls; a unit of IDEX Corporation.
 - g. Midwest Instruments & Controls Corp.
- 2. Description: Flowmeter with sensor and indicator.
- 3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
- 4. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.
 - a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for suitable for fluid being measured..
 - b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
 - c. Minimum Pressure Rating: 150 psig.
 - d. Minimum Temperature Rating: 180 deg F.
- 5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
- 6. Accuracy: Plus or minus 1-1/2 percent.
- 7. Display: Shows rate of flow, with register to indicate total volume in gallons.
- 8. Operating Instructions: Include complete instructions with each flowmeter.

2.12 ACTUATORS

A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

- 1. Manufacturers:
 - a. Belimo Aircontrols (USA), Inc.
 - b. Bray
 - c. Delta
 - d. Flow Design Inc.
 - e. Honeywell

- f. Johnson Controls
 - g. Siemens
 - h. Or equal standard products of the BAS manufacturer.
- 2. Each actuator shall be of sufficient capacity to operate the damper or valve under all conditions, and to guarantee tight close-off of dampers and valves against system temperature and pressure encountered.
- 3. Valves: Size for torque required for valve close off at maximum pump differential pressure.
- 4. Dampers: Size for minimum running torque calculated as follows:
 - a. Parallel-Blade Damper: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper: 5 inch-lb/sq. ft. of damper.
 - c. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by a factor of 1.5.
 - d. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by a factor of 2.0.
- 5. Coupling: V-bolt and V-shaped, toothed cradle. Provide actuators with proper linkages, mounting clamps and brackets for mounting and attaching to device. Actuators employing linkages between the actuator and damper/valve stem may be utilized subject to meeting specified requirements including additional start up requirements of Part 3.
- 6. Overload Protection: Electronic overload or digital rotation-sensing circuitry to prevent actuator damage due to stall throughout entire rotation. End switches to deactivate the actuator at end of rotation or magnetic clutches are not acceptable.
- 7. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
- 8. Power Requirements (Two-Position Spring Return): 24-V ac. If site conditions require the use of 120 V actuators, coordinate power requirements with the Division 26 contractor.
- 9. Power Requirements (Modulating): Maximum 10 VA while running and 5 VA while holding at 24-V ac or 8 W at 24-V dc.
- 10. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
- 11. Temperature Rating: Minus 22 to plus 122 deg F at 95% non-condensing relative humidity, unless noted otherwise.
- 12. Each actuator shall be full-proportioning or two position as indicated or specified. Provide actuators with spring return for normally open or closed position for fire freeze, moisture protection or fail safe operation on power interruption as indicated, specified and/or as required.
- 13. Actuators shall be constructed of galvanized steel, aluminum or stainless steel as required by applications and as specified.
- 14. Provide a two (2) year unconditional warrantee of actuator and, when utilized, linkages from the date of substantial completion.
- 15. Provide actuators with position feedback for proof of actual position and auxiliary switches as indicated in points list or sequence of operation. Position feedback is required for pump and fan control differential pressure reset.

16. The use of paralleled actuators to increase torque is acceptable.
17. Provide manufacturer's weather shield for actuators exposed to the weather.
18. Provide actuators with visual position indication.
19. Spring return actuators shall not exceed noise levels of 62 dBA when running. Non spring return actuators shall not exceed noise levels of 45 dBA when running. Spring return actuators shall include an electronic cutoff when holding at driven position so that holding noise level shall be inaudible.
20. MFT type programable proportional actuators shall be fully programmable actuators with position feedback and running time factory or field programmable. Provide Belimo MFT type actuator or approved equal. Actuator to include BACnet network connection with BAS.

B. Electronic Damper or Valve Actuators

1. Valve actuators shall include a thermal barrier and air space between valve and actuator to prevent condensation in actuator for chilled water applications.
2. Provide industrial actuators for butterfly valves 4" and larger and for damper exceeding 600 in-lbs of torque. Actuators shall include the following features:
 - a. Built-in thermostat and heater, pre-wired to a terminal block.
 - b. NEMA-4 enclosure
 - c. Provision for emergency manual over-ride
 - d. Electric motor brake
 - e. Accessible, adjustable end limit switches
 - f. Modulating actuators shall have a PC board that will allow for field changes to control input, control output, direction of rotation and calibration through pushbutton programming
3. Actuator shall be compatible with the controlled closure device requiring 7 to 15 seconds for damper closure to allow duct pressure equalizing.

2.13 CONTROL VALVES

A. Manufacturers:

1. Belimo
2. Bray
3. Flow Design Inc.
4. Honeywell
5. Johnson Controls
6. Siemens
7. Danfoss Inc.; Air Conditioning & Refrigeration Div.
8. Hayward Industrial Products, Inc.
9. Magnatrol Valve Corporation.
10. or equal standard products of the BAS manufacturer

- B. The BAS Contractor shall furnish all control valves as shown on the plans and/or as required to perform the control sequence specified. Equipment may be furnished with integral control valves in accordance with specifications.
- C. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- D. Hydronic system valves shall have the following characteristics:
 - 1. Sizing: 5-psig maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.
 - b. Two-Way Modulating: Either the value specified above or the load pressure drop, whichever is more.
 - c. Three-Way Modulating: The load pressure drop, but not more than value specified above.
 - d. Pressure Independent Control Two Way Valves: In accord with manufacturer's ratings for pressure drop and stable control.
 - 2. Flow Characteristics: Modulating 2-way valves shall have equal percentage flow characteristics; Modulating 3-way valves shall have linear flow characteristics maintaining a constant total flow at all valve positions.
 - 3. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head.
 - 4. Hydronic system globe valves shall have the following characteristics:
 - a. NPS 2 and Smaller: Class 250 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 - b. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 - c. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - 5. Characterized Ball Control Valves
 - a. At the Contractor's option, characterized ball type control valves can be used for hydronic systems where sizing permits.
 - b. NPS 3 and Smaller: Forged brass body with nickel plating, NPT screw type.
 - c. NPS 3 and Larger: Class 125 iron body, bronze trim, flanged ends.
 - d. Furnished with a stainless steel ball and stem and fiberglass reinforced Teflon or EPDM seats and seals.
 - e. The valves shall have an ISO type 4-bolt flange for mounting actuator in any orientation parallel or perpendicular to the pipe. A non-metallic thermal isolation adaptor shall separate the flange from the actuator.
 - f. The isolation adaptor shall also provide stable direct coupled mechanical connection between the valve body and actuator and prevent lateral or rotational forces from affecting the stem and its packing O-rings.
- E. Steam system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 3. Internal Construction: Replaceable plugs and stainless-steel seats.
 4. Sizing: For pressure drop based on the following services:
 - a. Two Position: 20 percent of inlet pressure.
 - b. Modulating 15-psig Steam: 80 percent of inlet steam pressure.
 - c. Modulating 16- to 50-psig Steam: 50 percent of inlet steam pressure.
 - d. Modulating More Than 50-psig Steam: As indicated.
 5. Flow Characteristics: Modified linear characteristics.
 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of operating (inlet) pressure.
- F. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
1. Body Style: Lug.
 2. Disc Type: Aluminum bronze.
 3. Sizing: 1-psig maximum pressure drop at design flow rate.

2.14 CONTROL DAMPERS

A. General

1. Provide 304 stainless steel construction when installed in stainless steel duct systems or when shown on the plans.
2. Outside air and exhaust air dampers shall not exceed Class I leakage ratings with a maximum leakage rate of 4 cfm per square foot at 1-inch wg pressure differential complying with the energy code.

B. Control Dampers

1. Manufacturers:
 - a. Air Balance Inc.
 - b. Greenheck
 - c. Pottorff; a division of PCI Industries, Inc
 - d. Ruskin
 - e. or equal standard products of the BAS manufacturer
2. The Control Contractor shall furnish all control dampers as shown on the plans and/or as required to perform the control sequence specified except those furnished with fan equipment. All modulating dampers shall be sized by the Control Contractor to meet

flow requirements of the application in accordance with his recommendation. All two position dampers to be sized as close as possible to duct size, but in no case is damper size to be less than 90% of duct area.

3. Dampers to be ultra-low leakage air foil type dampers equal to Model CD60, CD60SS or CD50 by Ruskin. Maximum open position pressure drop shall not exceed .08" W.G. at 2000 feet per minute face velocity across a 24"X24" damper.
4. Frame: Heavy gauge structural hat channel reinforced frame constructed of same material as damper to provide required rigidity for proper damper operation.
5. Blades: Low leakage, double-skin, air foil blades of galvanized steel or extruded-aluminum construction 14 gage equivalent thickness with blade seals suitable for air handling units differential pressures and velocities to 4000 FPM at temperatures from - 40 F to 200 F. Provide blade and seal designs to for differential pressures equal to the greater of 4" W.G. or associated fan's scheduled external static pressure.
 - a. Blade Design:
 - 1) Mixing applications (modulating or two position): Use parallel blade dampers configured to direct the mixing airstreams into each other.
 - 2) Modulating applications: Use opposed blade dampers.
 - 3) Two position applications: Use either opposed or parallel blade dampers.
6. Bearings: Self-lubricating stainless steel sleeve or non-corrosive molded synthetic.
7. Seals: Blade seals extruded vinyl edge seals mechanically attached to blades with flexible metal compression type end jamb seals.
8. Linkages and shafts: Linkages concealed in frame factory fabricated to connect damper shafts to actuator extended shaft with support brackets for shaft and actuator. Linkages and shafts to be stainless for stainless steel dampers and plated or stainless steel for aluminum or galvanized steel dampers, mechanically attached to blades. Each air handling damper shall actuate separately and are not physically linked to other dampers.
9. Single skin three longitudinal groove dampers equal to Ruskin CD36 are an acceptable alternate when damper is not part of building envelope (i.e. not outside air dampers) and for velocities up to 750 fpm and differential pressures to 4" W.G.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all control equipment and wiring in a neat and workmanlike manner to the satisfaction of the Architect and/or Engineer.
- B. All immersion wells, pressure tapings and any associated shutoff cocks, flow switches, level switches and other such items furnished by the control manufacturer shall be installed by the mechanical contractor under the coordinating control and supervision of the control contractor.
- C. Install all control devices in a location accessible to maintenance personnel. For example: above a lay-in ceiling and not a hard ceiling, actuators facing downward or sideways in congested areas, valves near floor level instead of at high points, etc.

- D. Provide, install, calibrate and demonstrate to the owner a complete and functioning control system per the specified sequence of operations and commissioning requirements.
- E. All wiring required for a full and functioning control system per the sequence of operations is work of this section.
- F. All control panels and monitors shall be provided, installed where shown on plans or detailed within the specifications and powered by the control system manufacturer/installer. Control panels provided to locations other than shown shall be provided, installed and powered by the control system manufacturer/installer. The controls contractor is to provide ample power wiring to power all panels from Power Panels as designated.
 - 1. Control panels for the rooftop air handlers shall be located at a location approved by the Architect/Engineer.
 - 2. Control panels for the indoor air handlers shall be located within the same room as the air handler.
- G. Provide and install all devices and wiring between HVAC manufacturer's factory installed equipment and all remotely mounted equipment such as flow switches and, data gathering cabinets and miscellaneous equipment for a complete and operating system.
- H. All terminations made within the control manufacturer/ installers panels shall be verified and tested prior to final powering of panel. Control devices from other systems shall not be temporarily or permanently mounted within the control panel.
- I. Electrical Wiring:
 - 1. All electrical wiring for the control system, including power circuit to control panels, both line and low voltage unless otherwise indicated, shall be furnished and installed by the control contractor in metal conduit and in accordance with all the electrical sections of this specification and all applicable electrical codes. This is in addition to power indicated on Division 26 drawings for control panels for air handling units and other pieces of mechanical equipment.
 - 2. Control panels serving equipment fed by emergency power shall be fed by emergency power. Coordinate all requirements with the Division 26 contractor.
- J. Electrical Work:
 - 1. Control Wiring: Control wiring shall be provided as a part of this specification section. Run all control wiring separate from power wiring, also do not utilize the same conduit for analog sensor wiring and any wiring carrying an AC current. Install wiring in accordance with the National Electric Code, and applicable local codes. All wire and wiring devices used shall be certified by the temperature controls subcontractor.
 - 2. Power Wiring: Power wiring to all DDC panels, VAV box controllers, and additional control devices as required, shall be provided as part of this work. Power circuits to DDC panels shall not be shared with any other electrical equipment. Power wiring required by the control manufacturer/installer for electric end devices (eg: actuators, relays, etc.) is work of this section. All conduit, wire, hangers, etc. associated with wiring to end devices is work of this section.
 - 3. All EMT shall be a minimum of 3/4" in diameter. Steel compression fitting shall be used to join EMT with electrical boxes, cabinets and panels.

K. Test And Balance And Commissioning:

1. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance and commissioning purposes.
2. The Contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
3. In addition, the Contractor shall provide a qualified technician to assist in the test and balance and commissioning process.
4. The tools used during the test and balance and commissioning process will be returned at the completion of the testing and balancing and commissioning.

L. Work By Others:

1. All valves and dampers shall be installed by the mechanical contractor. All pipe and duct penetrations shall be provided by the mechanical contractor, or his designated subcontractor.
2. Strainers: Pump strainers and branch strainers are provided and installed by the mechanical contractor. Coordinate requirement for strainers for control valves and devices with contractor.

M. Dampers:

1. All dampers furnished by the control manufacturer shall be installed by the mechanical contractor under the coordinating control and supervision of the control contractor.
2. Any necessary blank-off plates or transitions required to facilitate the standard size dampers shall be provided by the mechanical contractor. In areas where the damper is 70% or more of the duct area, blank-off plates are to be used. In areas where the damper is less than 70% of the duct area, a transition shall be provided.

N. Valves:

1. All temperature control valves, furnished by the control manufacturers shall be installed by the mechanical contractor under the coordinating control and supervision of the control contractor.
2. Valve submittals shall be coordinated for type, quantity, size and piping configuration to ensure compatibility with pipe design.
3. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.
4. Valves shall be installed in accordance with the manufacturer's recommendations. Installation in a horizontal pipe run is preferred.
5. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
6. Unions shall be installed at all connections to screw-type control valves.
7. Provide tags for all control valves indicating service and number. Match identification numbers as shown on approved controls shop drawings.

8. Provide pressure independent control two way valves as specified or when indicated. Balance valves or automatic flow control valves are not to be utilized in series with PICVs.

O. Freezestats:

1. Install freezestats in all air handling units where indicated on the drawings or as specified. Unless otherwise indicated, install sensing element at the downstream side of heating coils.
2. Distribute sensing element across the entire area of the medium being sensed. Install stats at accessible locations with suitable mounting brackets and element duct collars where required.

P. Specialized Space Monitor:

1. Install room DP monitors adjacent to door outside of the control space being monitored. Control spaces with ante rooms to include either single monitor to monitor either spaces or two monitors. Mount DP monitor, accessories and sensors per manufacturer's instructions with pressure pickups above the door or in ceiling away from influence of supply air jets.
2. Install multivariable monitors adjacent to other room sensors or as indicated.
3. Provide factory-authorized representative to perform start up, initial field calibration of the controller and Owner training.
4. Coordinate start up and set points with Test and Balance and the building control system.

Q. Connect flowmeter-system elements to meters.

R. Connect flowmeter transmitters to meters.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Controllers:

1. Install local application specific controllers where indicated on the plans or suitable location adjacent to the system served. Mount panel on wall with suitable brackets. Coordinate controller locations with other trades.

D. Duct/Piping Sensors:

1. Install duct pressure, temperature or humidity sensors where indicated or directed to meet job site conditions.
2. Mount all sensors per manufacturer's requirements.
3. Relocate duct sensors if required due to improper sensing.

4. Mount averaging sensors with serpentine sensing element across the entire area of the medium being sensed. Install sensors at accessible locations with suitable mounting brackets and element duct collars where required.
 5. Install piping sensors on top of piping. Insulate duct and pipe sensors to prevent condensation of cold surfaces.
 6. Provide matched temperature sensors for chilled and hot water differential temperature measurement. Differential accuracy shall be within 0.2° F.
 7. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
 8. For immersion sensors with wells, install thermal grease in well to improve conductivity.
- E. Install automatic dampers according to "Air Duct Accessories."
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- H. Install labels on temperature and humidity sensors indicating the controlled device or equipment. Coordinate label style and location (e.g. Kroy/P-Touch tape, color coded dots, etc.) with architect and owner. Locate label on back of sensor cover where possible.
- I. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- J. Install flowmeter elements in accessible positions in piping systems with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- K. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- L. Install flowmeters at discharge of hydronic system pumps and where indicated on the drawings.
- M. Assemble components and install thermal-energy meters.
- N. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 2. Install exposed cable in raceway.
 3. Install concealed cable in raceway.
 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- D. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 6. Test each system for compliance with sequence of operation.
 7. Test software and hardware interlocks.
- C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 6. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 7. Check temperature instruments and material and length of sensing elements.
 8. Check control valves. Verify that they are in correct direction.
 9. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.

- c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 - c. Calibrate meters according to manufacturer's written instructions, after installation.
6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.

9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

1. Upon completion of the work and acceptance by the Owner, the installing Contractor shall provide installation/operation information to the Owner's operating personnel who have responsibility for the mechanical system. The contractor shall provide telephone support to the owner's operating staff for a period of one year for no additional cost.
2. Contractor shall provide twenty (20) hours of training, in blocks of 4 hours, during normal business hours to a minimum of two (2) owner's representatives designated by the facility. Training subjects and format shall be subject to the Owner's approval. Training shall be digitally recorded by the Controls, to be handed over the facility for future use.

B. HARDWARE SUPPORT

1. The manufacturer of the DDC system shall provide assistance in product applications and system trouble shooting. The materials and installation shall be guaranteed to be free of defects for one (1) year from date of beneficial use.

3.7 SYSTEM ACCEPTANCE

- A. Upon completion of the project, the Building Automation System contractor shall:

1. Completely adjust or calibrate all devices provided under this section.
2. Provide testing and adjustment of the complete system as required per code or specification. Validate system points from the Personal Computer Operator Workstations to the field points.
3. Test connected devices so that the displayed controlled variable is within plus or minus 2% of the actual sampled variable.
4. Test remote access capabilities of the system including verifying remote alarm functionality.
5. Participate and support commissioning efforts

- B. The installing Contractor shall issue a report upon project completion stating that the system has been completed and adjusted has had all hardware and software functions verified, and is operating in accordance with the specifications. Any deviations from specified settings or

operations necessitated during system adjustment shall be specifically noted. A demonstration of complete system operation shall be made to the Owner's representative.

END OF SECTION 230900

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Hot-water heating piping.
 - 2. Makeup-water piping.
 - 3. Drain and Vent piping.
 - 4. Safety-valve-inlet and -outlet piping.
- B. Related Sections include:
 - 1. Division 23 Section "Vibration Controls for HVAC".
 - 2. Division 23 Section "Hydronic Pumps".
 - 3. Division 23 Section "Hydronic Piping Specialties".
 - 4. Division 23 Section "General-Duty Valves for Hydronic Piping".
 - 5. Division 23 Section "Hangers and Supports for HVAC".

1.3 DEFINITIONS

- A. Design Pressure: Minimum required pressure rating requirement at indicated operating temperature of piping systems and associated valves, fittings, and specialties for sustained operation.
- B. Maximum System Design Pressure: Maximum sustained operating pressure during normal operating conditions in associated piping systems, typically downstream of the pump.
- C. Working Pressure: Maximum sustained operating pressure during normal operating conditions in associated piping systems, typically downstream of the pump.

1.4 PERFORMANCE REQUIREMENTS

- A. Products shall be suitable for piping system fluids, materials, pressures, and temperatures.
- B. Hydronic piping, components, fittings, specialties, and installation shall withstand the following minimum design pressure and temperature:
 - 1. Copper Tube: 125 psig at 200 deg F.
 - 2. Schedule 40 steel Pipe: 125 psig at 200 deg F.

3. Makeup-Water Piping: Equal to the pressure of the piping system to which it is attached.
 4. Drain and Vent Piping: Equal to the pressure of the piping system to which it is attached.
 5. Hydronic Fittings, Valves, Meters and Specialties: Equal to the pressure of the piping system to which it is attached.
 6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.
- C. Hydronic piping, components, fittings, specialties, and installation shall withstand pressures required by pressure test requirements of these specifications. Pressure test of hot systems to be performed at reduced temperature.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following, provide product data for all items including as applicable dimensions, capacities, materials of construction, non-compatible fluids, pressure and temperature ratings, pressure drop and appropriate identification:
1. Pipe and fittings.
 2. Grooved mechanical joint fittings.
- B. Shop Drawings:
1. Detail, at 1/8" scale, coordinated piping drawings.
 2. Include details for fabrication of hangers, supports for multiple pipes, pipe anchors and guides, expansion joints, pipe bends and loops, and attachments of the same to the building structure.
 3. Detail location of anchors, alignment guides, and expansion joints and loops.
 4. For preinsulated piping systems, the supplier shall provide the 1/8" coordinated piping drawings. Include for underground piping trenching requirements, pipe insulation, fitting insulation and means to control and accommodate thermal piping expansion.
- C. Delegated-Design Submittal:
1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion fittings and loops, and attachments of the same to the building structure.
 2. Locations of pipe anchors and alignment guides and expansion fittings and loops.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals. Include special warranty.

1.7 QUALITY ASSURANCE

- A. Hydronic piping, specialties and components shall be fabricated and installed to comply with ASME and ASTM Standards.
- B. Installer Qualifications:
 - 1. Installers of Press fitting Joints: Installers shall be certified by the press fitting manufacturer as having been trained and qualified to join piping with press fittings.
- C. All grooved joint couplings, fittings, valves, and specialties shall be of the same manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - 1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability
 - 2. Inspection Requirements:
 - a. A manufacturer's factory trained representative shall periodically visit the job site and review the installation for best practices. This shall be at the expense of the installing contractor. The installing Contractor shall correct any identified deficiencies.
 - b. Any grooved product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Inspection Services prior to the completion of the project. Any grooved product that has not been corrected or was not examined will not be considered as part of the successful completion of Inspection Services
- D. Steel Support Welding: Qualify procedures and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- E. Pipe Welding: Qualify procedures and operators according to ASME standards including Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Hydronic piping, components, fittings, specialties, and installation shall be suitable for indicated service with design pressure and temperature ratings as indicated in Part 1 "Performance Requirements" Article.
- B. Hydronic piping, components, fittings, specialties, and installation shall withstand 1.5 times the system's working pressure for pressure test requirements. Working pressure of 100 psig unless indicated otherwise on expansion tank schedule.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper (hard) Copper Tubing: ASTM B 88, Type L.
- B. Copper and Copper Alloy Fittings: Soldered or brazed joints.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe – 2" and smaller: ASTM A 53/A 53M, black steel with plain ends; Grade B, type E electric resistance welded, or Grade A, type F continuously welded, schedule 40.
- B. Steel Pipe – 2 ½" and larger: ASTM A 53/A 53M, black steel with plain ends; Grade B, type E electric resistance welded, schedule 40.
- C. Cast-Iron Threaded Fittings: Classes 125, 250 or higher as required by Part 1 "Performance Requirements" Article.
- D. Malleable and ductile Iron Threaded Fittings: Classes 150, 300 or higher as required by Part 1 "Performance Requirements" Article.
- E. Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- F. Forged-Steel Flanges and Flanged Fittings: Classes 125, 150 or higher as required by Part 1 "Performance Requirements" article including bolts, nuts, and gaskets.
- G. Stainless Steel Pipe and fittings: ASTM A 312/A 312M type 316L stainless steel pipe, type S seamless, schedule 40 with flanged or welded fittings.

- 1. At the Contractor's option in lieu of threaded steel or soldered copper in applicable piping systems NPS 2 (50mm) and smaller, ASTM A312, Schedule 10S, Type 304/304L stainless steel pipe with plain ends and Vic-Press fittings and couplings may be used.

- a. Fittings: Precision, cold drawn, stainless steel with elastomer O-ring seals.
- b. System suitable for working pressure to 500-psig (3450-kPa)

H. Grooved Mechanical Joint Fittings and Couplings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company of America.
 - c. Grinnell.
- 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B factory-fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings
- 3. Couplings: Two ductile-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with ASTM A449 nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings. Couplings shall comply with ASTM F1476 – Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

- a. Rigid Type: Coupling housings 12" and smaller cast with offsetting, angle-pattern, bolt pads for joint rigidity and support and hanging in accordance with ANSI B31.1 and B31.9. Visual confirmation of proper assembly upon bolt pad contact without a torque requirement. Designs that require a torque or permit bolt pad spaces (gaps) per written installation instructions not permitted.
 - 1) Installation-Ready, for direct stab installation without field disassembly, including a grade EHP gasket, suitable for water temperatures to +250 degrees F. Victaulic Style 107N or equal.
 - b. Flexible Type: May be used to provide for vibration attenuation and thermal pipe expansion in lieu of expansion devices. Victaulic Installation-Ready Style 177 and Style 77 or equal.
 - c. 14" and Larger: Victaulic AGS series two-segment coupling with lead-in chamfer on housing key and wide width FlushSeal gasket. Basis of Design: Victaulic Style W07 (rigid) and Style W77 (flexible) or equal.
- 4. Mechanical-T outlets are acceptable for sizes up to 1" and only for pressure and temperature piping connections to the piping system, for thermowells and other connections where the outlet will not have water flow. They are not allowed for branch runouts from mains and runouts to mechanical equipment.
 - 5. Factory-fabricated grooved end header and Factory-Assembled grooved end Pump Drops may be utilized for headers and pump connections. All components shall be provided per the pump details and other requirements of the specifications.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Nonmetallic, flat, asbestos-free, suitable for chemical, thermal and pressure conditions of piping system contents and piping components being joined.
- B. Flange Bolts and Nuts: Carbon steel, unless high strength steel is required for high temperatures and pressure.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; or BAg1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Grooved Joint Lubricants: Lubricate gaskets in accordance with the manufacturer's published installation instructions, using lubricant compatible with the gasket elastomer and fluid media. Basis of Design: Victaulic Vic-Lube.

2.5 TRANSITION FITTINGS

- A. Unions: Assembly of steel, copper, or copper alloy to match associated piping systems with neoprene gasket and with threaded, solder-joint, plain, grooved or weld-neck end connections that match piping system materials.

2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with insulating material and with threaded, solder-joint, plain, grooved, fusion weld or weld-neck end connections that match piping system materials
- B. Dielectric Unions: Factory-fabricated, union assembly with neoprene gasket.
- C. Dielectric Flanges: Factory-fabricated, companion-flange assembly including bolts, nuts, and gaskets.

PART 3 - EXECUTION

3.1 PIPING SCHEDULES

- A. Hydronic piping, components, fittings, specialties, and installation shall suitable for indicated service with design pressure and temperature ratings as indicated in Part 1 "Performance Requirements" Article.
- B. Fittings, specialties and valves to be compatible with associated piping systems utilizing soldered, brazed, press fittings, grooved, screwed, welded, flanged, solvent cement or fusion welded fittings as indicated in Part 2 specifications.
- C. Minimum piping size shall be $\frac{3}{4}$ ". $\frac{1}{2}$ " or smaller piping sizes are prohibited.
- D. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
 - 1. Copper tubing (hard), copper and copper alloy fittings.
 - 2. Steel pipe; Steel, ductile or malleable iron fittings.
 - 3. Polypropylene, pipe and socket fusion, fusion outlet, or electrofusion fittings. Valves may be polypropylene when provided by the piping manufacturer.
 - 4. PEX-a, pipe and manufacturer's fittings and assemblies.
- E. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
 - 1. Steel pipe, steel fittings.
 - 2. Polypropylene, pipe and socket fusion, fusion outlet, or electrofusion fittings. Valves may be polypropylene when provided by the piping manufacturer.

3.2 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel or groove plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Copper Pipe Joints:

1. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
2. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
3. Press fitting Joints: In accord with manufacturer's installation instructions. Tubing shall be full inserted into fitting and marked. The fitting alignment checked against the mark to assure the tubing is fully engaged. The joints shall be sealed by pressing tools approved by the manufacturer.

D. Steel Pipe Joints

1. Threaded Joints: Thread pipe with tapered pipe threads according to ASME. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
2. Welded Joints: Weld steel joints according ASME code, ANSI and State codes as applicable, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
3. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
4. Grooved Mechanical Joint: In accord with manufacturer's installation instructions. Cut or roll groove in pipe and remove all cutting residue. Apply joint lubricant to gasket and pipe ends. Install gasket, align pipe ends and gasket, and secure fitting housing.

3.3 PIPING INSTALLATIONS

- A. Refer to other Division 23 specifications including Common Work Results for HVAC for additional requirements.
- B. Install piping to allow for thermal expansion using offsets, loops, swing joints, expansion joints, vibration isolation and anchors as necessary to limit stress. Connect risers, branches and run outs to terminal equipment to main or branch lines with at least three pipe fittings, including tee in main or branch.
- C. During construction, provide temporary end caps on all piping to prevent dirt and debris from entering the piping system.
- D. Use only long radius elbows having a center line radius of 1.5 pipe diameters for copper and steel systems. In Victaulic installations, standard "as-cast full-flow" fittings shall be used.
- E. "Weld-o-lets" and "Thread-o-lets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

- F. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with chained cap, at low points in piping system mains and elsewhere as required for complete system drainage.
- G. Install all valves, control valves and piping specialties including items furnished by others as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping service indicated in this section.
- H. Steel condenser water piping located in corrosive environments and in exterior locations shall be epoxy painted to prevent corrosion.
- I. Install dielectric fittings in piping systems where indicated and at connections of dissimilar metals: including but not limited to steel to copper connections. Install unions or flexible hose connectors with unions for piping NPS 2 and smaller. Install flanges for piping NPS 2-1/2 and larger. Teflon tape is not acceptable substitute for a dielectric fitting.
- J. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated. Identify on exterior of insulated cold piping systems locations of unions. Unions are to be installed on the equipment side of shut-off valves.
- K. Flexible hose connectors with unions may be applied for piping NPS 2 and smaller for connections to equipment and to facilitate flushing of piping systems. Coordinate application with vibration isolation specifications. Flexible hose connectors are to be installed on the equipment side of shut-off valves.
- L. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- M. Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as disconnect points if required.)
- N. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service. A factory-trained field representative (direct employee) of the mechanical joint manufacturer shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed. Contractor shall remove and replace any improperly installed products.
- O. Pitch horizontal mains up at 1 inch in 40 feet in the direction of flow. Install manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air vent piping to the nearest code acceptable drain location with vent valve located at the drain.
- P. Main branches and runouts to terminal equipment may be made at the top, side or bottom of the main, provided that there are drain valves suitably located for complete system drainage and manual air vents are located as described above.
- Q. Use top connection to main for upfeed risers and bottom connection to main for downfeed risers. Connections at a main may be made with a tee and a 45-degree elbow.
- R. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 CHEMICAL TREATMENT

- A. Install chemical treatment piping as indicated on the drawings, as detailed, as specified, and as recommended by the supplier of the chemical treatment equipment.

- B. When expanding existing systems, coordinate with facility's existing chemical treatment program to establish an existing chemical balance of the piping system prior to connecting new work. Upon completion of the new piping installation, return the chemical balance to the recommended chemical levels.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC."

3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections and associated specialties shall be the larger of that indicated on the plans or the associated equipment connection. Branch transitions, when required, shall be located at the point of connection to the equipment.
- B. Install control valves and strainers in accessible locations close to connected equipment.
- C. Provide temporary bypass piping around terminal equipment including, coils, heat exchangers, chillers and boilers to allow for flushing and cleaning of piping systems. Flexible hose connectors if included in Hydronic Piping Specialties specifications may be applied to use as bypass piping.

3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping for hydrostatic pressure test according to ASME and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush and clean hydronic piping systems with clean water; then remove and clean or replace strainer screens. Refer to Common Work Results for HVAC for additional requirements.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve.
 - 5. Install temporary pressure relief valves, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following piping system hydrostatic leak tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and make up water and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure at low elevation point of the system that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stresses do not exceed values in ASME. Hydrostatic test piping systems at the higher value of 100 psig or 1.5 times the system's working pressure.
 - a. Note: Some manufacturers of various system components such as press fittings require a lower pressure test. Should the contractor install any system components that the manufacturer specifically requires a lower pressure test, this shall be completed prior to that indicated here. The manufacturer's testing requirements shall be adhered to.
 5. Measure and record test pressure at the low point in the system.
 6. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
 7. Reduce system pressure back to system fill pressure and reconnect expansion tank and make up water.
 8. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Verify make up water pressure reducing valve is set for required system pressure.
 4. Install pressure relief valve set for required system pressure.
 5. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 6. Set temperature controls so all coils are calling for full flow.
 7. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 8. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232117 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Air Vents and Separators.
 - 2. Expansion Tanks.
 - 3. Glycol Makeup Units.
 - 4. Filter Chemical Feeders.
 - 5. Strainers.
 - 6. Pump specialty fittings.
 - 7. Pressure relief valves.
 - 8. Flexible Hose Connectors.
 - 9. Thermometers and gauges.
- B. Related Sections include:
 - 1. Division 23 Section "Vibration Controls for HVAC".
 - 2. Division 23 Section "Hydronic Piping".

1.3 PERFORMANCE REQUIREMENTS

- A. Products shall be suitable for piping system fluids, materials, pressures, and temperatures.
- B. Hydronic piping specialties and installation shall withstand the minimum design pressure and temperature and test pressure as specified in Hydronic Piping.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of specialty indicated, provide product data including applicable dimensions, capacities, materials of construction, non-compatible fluids and pressure and temperature ratings.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For hydronic specialties, include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Hydronic piping and specialties, safety valves, pressure vessels shall be fabricated and installed to comply with ASME. Safety valves, relief valves and pressure vessels shall be ASME labeled to comply with ASME standards including Boiler and Pressure Vessel Code.
- B. Pipe Welding: Qualify procedures and operators according to ASME standards including Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Hydronic piping specialties and installation shall be suitable for indicated service with design pressure and temperature ratings as indicated in Part 1 "Performance Requirements" Article.
- B. Hydronic piping specialties and installation shall withstand 1.5 times the system's working pressure for pressure test requirements.
- C. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger. End connections may be pressure seal or grooved compatible with associated piping systems when specified in Hydronic Piping.
- D. Finish: Manufacturer's standard paint or galvanized construction to resist corrosion for specialties constructed of steel.
- E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amtrol, Inc.
 - 2. Armstrong Pumps, Inc.
 - 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - 4. Griswold
 - 5. Flow Design, Inc
 - 6. Metraflex.
 - 7. Nibco
 - 8. Red-White Valve Corp.
 - 9. Taco.
 - 10. The John Wood Company
 - 11. Spirotherm.
 - 12. Victaulic Company.
 - 13. Caleffi.

2.2 AIR CONTROL

A. Manual Air Vents:

1. NPS 1/4 brass needle type valves with screwed cap.
2. NPS 1/2 full-port, two piece bronze ball valve with screwed cap and chain.
3. Waste Connector: When indicated to pipe vents to drains.

B. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. High Capacity type: NPS 3/4 inlet and NPS 3/8 outlet.
5. Standard Capacity type: NPS 1/2 inlet and 1/4 outlet with manufacturer's screw cap.
6. Waste Connector: When indicated to pipe vents to drains.

C. Expansion Tanks:

1. Tank: Welded steel, bladder type tank. Factory test with taps fabricated and supports installed and labeled according to ASME.
2. Securely seal membrane into tank to separate air charge from system water. Membrane to be heavy duty butyl rubber suitable for associated closed loop fluid with a pressure rating equal to the tank. Flanged cover access port to access bladder.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
4. Diaphragm tanks may be used up to 35 gallons of acceptance volume, if scheduled.
5. Bladder tanks shall be Full Acceptance volume replaceable type with water in bladder.

D. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed centrifugal type air separator with sufficient volume for velocity reduction to maximize air separation.
2. Optional strainer: When scheduled, perforated stainless steel removable strainer with 3/16" perforations and minimum 50 percent free area.
3. Blowdown Connection: Threaded.
4. Vent Connection: Threaded minimum of NPS 3/4 for high capacity air vent.
5. Size: Match system flow capacity.

2.3 GLYCOL MAKEUP UNIT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bell and Gossett
2. Neptune.

- B. Provide a packaged, automatic glycol solution makeup unit consisting of steel base, polyethylene reservoir with removable lid, visible solution level scale in gallons, pump, expansion tank and control panel.
- C. Glycol Tank: High density polyethylene with minimum 50 gallon capacity and liquid level scale.
- D. Pump: 120V pump with capacities as scheduled on drawings.
- E. Expansion Tank: 2.2 gallon capacity with 125 psi pressure rating
- F. Piping: Steel piping system with isolation valves, pump isolation valves, check valve, balancing valves, pressure relief valve, and y-strainer with 20 mesh stainless steel screen.
- G. Controls: Control panel with NEMA rating suitable for the environment the unit is installed in. Controls shall consist of adjustable pressure switch, visible range scale, low-level safety float switch, low-level NC/NO dry contacts for remote monitoring, pressure gauge, and power on, run and low level lights.
- H. Base ring for installing tank on a level surface

2.4 FILTER FEEDER

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Neptune.
 - 2. Pentair.
 - 3. Rosedale.
- B. Product shall allow chemical addition and high-capacity filtering in one combined piece of equipment.
- C. Construct housing of stainless steel with ASME stamp. Provide filter access with gasketed steel or cast iron head.
- D. Construct filter cartridges of disposable media with a minimum media area as required to meet clean filter pressure drop scheduled, or if not indicated to limit to 3 PSI.. Cartridges shall be rated to remove in a single pass 95% of all solid particles from 1 to 100 microns, see schedule for filtration particle size or if not indicated provide 30 micron filtration. To insure against bypassing, provide a positive seal on each cartridge stack consisting of an internal tie rod and seal nut arrangement, or equivalent. Where more than one cartridge is employed per stack, provide an appropriate coupler between the cartridges to guarantee good sealing and freedom from bypass. Cartridges shall be capable of proper operation at pressure differentials up to 100 psig.
- E. Working pressure: Up to 300 PSI at 200 deg F.
- F. Provide mechanical cover lifts for filters with inlets and outlets 4 inches and greater.
- G. Provide initial set of cartridges for each filter plus three (3) spare sets.

2.5 STRAINERS

- A. Y-Pattern Strainers:
 - 1. Body:

- a. ASTM A 126 cast iron with screwed cap or bolted cover and bottom drain connection.
 - b. ASTM A 536 ductile iron with coupled cap for strainer access.
 - c. ASTM B 62 bronze with screwed cap and bottom drain connection.
2. Strainer Screen: Stainless steel 20 mesh strainer for NPS 2 (DN 50) and smaller, and perforated stainless-steel basket with stainless steel fine mesh start up screens for NPS 2-1/2 (DN65) and larger as indicated in Part 3.
 3. Blow down: Blow down ball or gate type valve with hose end connection and chained cap when blow down is not piped to drain.

2.6 PUMP SPECIALTY FITTINGS

A. Pump Suction Diffuser:

1. Body: Angle pattern, cast or ductile-iron body and end cap, flanged inlet and outlet fittings with transition to match pump inlet; bronze or stainless-steel straightening vanes; drain connection; and factory-fabricated support.
2. Strainer Screen: Perforated stainless-steel basket with stainless steel fine mesh start up screens for NPS 2-1/2 (DN65) and larger as indicated in Part 3.
3. Drain Plug
4. Factory-fabricated support.

B. Triple Duty Valves:

1. Body: Angle pattern, cast or ductile-iron body, pump-discharge fitting; with removable valve components and shutoff, balancing and spring loaded non-slam disc check valve features. Valve components to be removable for service without disconnecting valve assembly from piping.
2. Valve with multi-turn stem and memory stop to allow valve to be returned to its original position after shutoff.
3. Trim: Brass gauge ports with integral check valve and calibrated balancing valve for flow measurements. Valve shall have calibrated scale to determine total flow by pressure reading across the valve.
4. Disc: Bronze with stainless steel trim and springs.
5. Seat: Bronze with EPDM seat.
6. Valve Stem: Stainless steel.

2.7 SPECIALTY VALVES

A. ASME Safety Relief Valves

1. Body: Bronze or brass, NPT threaded inlet and outlet, brass seat, diaphragm type stainless steel spring and test lever.
2. ASME type for temperature and pressure relief.
3. Sized to exceed BTU rating of the boiler's heating output, factory set for relief pressure with tag.

2.8 FLEXIBLE HOSE CONNECTOR

1. Flexible stainless 25 / 50 fire smoke rated steel hose assembly NPS 2 and smaller, rated for pressures to 400 PSI, minimum, at 200 F. Construction shall include an inner CEP or EPDM tube with a stainless steel braded cover with brass threaded fittings with a swivel union fitting at one end to allow removal for service and short circuiting the coil during flushing. Flexible connections shall be suitable for pressure, temperature and fluid for intended service.
2. Minimum bend radius of 7" for ¾" hose, 8" for 1", 10" for up to 2".
3. Hose to be pressure tested to 450 psi.

2.9 THERMOMETERS AND GAUGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal by manufacturers listed for Hydronic Piping Specialties:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Marsh Bellofram.
4. Miljoco Corp.
5. Palmer - Wahl Instruments Inc.
6. REO TEMP Instrument Corporation.
7. Trerice, H. O. Co.
8. Weiss Instruments, Inc.
9. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
10. Wika.
11. Winters Instruments

- B. Test Plugs

1. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

- C. Liquid-In-Glass Thermometers

1. Case: Cast aluminum; 9-inch nominal size.
2. Case Form: Adjustable angle unless otherwise indicated.
3. Tube: Glass with magnifying lens and fill of spirit type blue organic liquid.
4. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
5. Window: Glass.
6. Stem: Material and of length to suit installation.
7. Connector: 1-1/4 inches.
8. Accuracy: Plus or minus one scale division, to a maximum of 1.5 percent of scale range. Range for thermometers shall be:

<u>Service</u>	<u>Scale Range</u>	<u>Increment</u>
Hot Water	30 deg. F. to 240 deg.F.	2 deg. F.

D. Bimetallic-Actuated Thermometers

1. Case: Sealed type; stainless steel with 3-inch nominal diameter.
2. Dial: Minimum 3" dial size, nonreflective aluminum with permanently etched scale markings and scales in deg F.
3. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
4. Connector Size: 1/2 inch.
5. Stem: Material and of length to suit installation.
6. Window: Glass; Plastic or glass if in conditioned spaces.
7. Ring: Stainless steel.
8. Element: Bimetal coil.
9. Pointer: Dark-colored metal.
10. Accuracy: Plus or minus 1 percent of scale range.
11. Range for thermometers shall be:

<u>Service</u>	<u>Scale Range</u>	<u>Increment</u>
Hot Water	20 deg. F. to 240 deg.F.	2 deg. F.

E. Direct-Mounted Light-Activated Thermometers

1. Case: Metal; 7-inch linear or 4 1/2" (115-mm) diameter nominal size.
2. Scale(s): Deg F.
3. Case Form: Adjustable angle.
4. Sensor: Thermistor.
5. Connector: 1-1/4 inches.
6. Stem: Material and of length to suit installation.
7. Display: Digital.
8. Accuracy: Plus or minus 2 deg F.

F. Thermowells

1. Manufacturers: Same as manufacturer of thermometer being used.
2. Provide for all thermometers and temperature sensors in hydronic piping systems.
3. Description: Pressure-tight, socket-type stainless steel fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Provide extension neck for insulated piping systems.

G. Stems

1. Aluminum, brass or stainless steel construction for use with thermowell in piping systems.
2. Air duct style with perforated guard for use with ductwork. Provide stainless steel construction for use in stainless steel, aluminum or corrosion resistant coated duct systems.

H. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type.

1. Case: Liquid-filled type, drawn stainless steel or cast aluminum, 4-inch minimum diameter.
2. Pressure-Element Assembly: Brass or stainless steel bourdon tube.
3. Pressure Connection: NPS 1/4, bottom-outlet type.
4. Movement: Brass or stainless steel mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Black aluminum.
7. Window: Glass; Plastic or glass if in conditioned spaces.
8. Ring: Stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of scale range,
10. Standard range for pressure gauges shall be:

<u>Service</u>	<u>Scale Range</u>	<u>Increment</u>
High Side Gauges – Closed Loop Systems including hot water	0 psig to 160 psig.	2 psi.
Low Side Gauges – Closed Loop Systems including hot water	0 psig to 100 psig.	1 psi

11. For primary secondary closed loop systems, provide low side gauges at chillers, boilers and associated primary pumps. All other gauges are high side gauges, unless noted otherwise.
12. Range for Working Pressure above 125 psig: 0 psig to 200 psig or to working pressure, whichever is larger.

I. Pressure-Gauge Fittings:

1. Gauge Valves: NPS 1/4 brass or stainless-steel needle type.
2. Snubbers: NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine specialties interiors for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Examine threads and mating pipe for form and cleanliness.

- C. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- D. Do not attempt to repair defective valves and specialties; replace with new.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 INSTALLATION

- A. Hydronic specialties and installation shall be suitable for indicated service with design pressure and temperature ratings as indicated in Part 1 "Performance Requirements" Article.
- B. Specialties to be compatible with associated piping systems utilizing soldered, brazed, press fittings, grooved, screwed, welded or flanged fittings as indicated in Part 2 specifications.
- C. Compliance: In accord with approved submittals and manufacturer's written installation instructions.
- D. Provide stainless steel construction option for specialties when used on piping systems in corrosive environments. Refer to Division 23 Section "Hydronic Piping" for systems considered corrosive.
- E. Flexible hose connectors with unions may be applied for piping NPS 2 (DN 50) and smaller for connections to equipment and to facilitate flushing of piping systems. Coordinate application with vibration isolation specifications. Flexible hose connectors are to be installed on the equipment side of shut-off valves. Flexible hose connector size shall be runout size and not equipment connection size.
- F. Identify specialties as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- G. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Utilize high capacity type air separator. Install shut off valve upstream of each automatic air vent for service.
- H. Install manual air vents at high points of system piping, heat-transfer coils and elsewhere as required for air venting and system draining.
- I. Route air vents to drain when indicated with copper or PEX tubing. Provide chained caps for manual air vents when not routed to drain.
- J. Install thermometer and gauges in locations indicated on the drawings and details.
 - 1. Install gauges for water service with pressure snubbers and gauge valves.
 - 2. Install thermometers with heat transfer paste in thermowells with minimum stem insertion lengths of 2".
 - 3. For pipe sizes 2" and smaller, install thermowells in side tap of full size piping tee with stem insertion length of approximately ½ pipe size .
 - 4. Adjust faces of thermometers and gauges to proper angle for best visibility.

- K. Install gauge and thermometer tapings at each point where a sensing device is required under Division 23 Sections "Instrumentation and Control for HVAC" and at locations as shown on the drawings and details. Install gauge tapping with snubbers and gauge valves.
- L. Install test plugs in water systems as detailed and on entering and leaving side of all strainers, heat exchangers, water coils, chillers and pumps, and at control system pressure and temperature sensors.
- M. Air separators:
 - 1. Install type of air separator in location as shown on the plans, details and/or schedules.
 - 2. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
 - 3. Provide full sized isolation valves when provided with strainer or similar water cleaning elements requiring service.
- N. Expansion Tanks:
 - 1. Install expansion tanks, accessories and adjust pressure devices as indicated on the plans, details, and/or schedules.
 - 2. Work includes setting tank air charge, make up water pressure reducing valve fill pressure and maximum pressure at pressure relief valve as well as interconnecting piping, piping accessories and correct location of air separating device.
 - 3. Install the tank connection after the air separator and before the pumps, unless indicated otherwise.
 - 4. Prior to opening the expansion tank isolation valve to the system, verify make up water pressure reducing valve is maintaining the minimum pressure as scheduled or submitted for that system's expansion tank.
- O. Pump Specialty Fittings:
 - 1. Pump suction diffusers without strainer screens and baskets may be used for pumps when space does not permit 5 diameters of straight pipe at the pump inlet.
 - a. Verify suction diffuser screens are removed.
 - b. Verify y strainer upstream of pump is installed.
 - 2. Triple Duty Valves may only be used for constant flow systems. They are not allowed for variable flow systems. If used for constant flow systems, provide additional shutoff valve downstream of triple duty valve.
- P. Pressure Reducing Valve:
 - 1. Install pressure reducing valve at make-up water connection and adjust pressure as indicated on the plans, details and schedules.
 - 2. Set pressure reducing valve to minimum pressure value indicated on expansion tank schedule, or if not indicated, to 15 psig.
- Q. Pressure Relief Valve:

1. Install pressure relief valve and adjust pressure as indicated on the plans, details and schedules.
2. Provide a pressure relief valve in each closed loop water system. Provide at pump inlet piping, unless otherwise indicated.
3. Set pressure relief valve to maximum pressure value indicated on expansion tank schedule, or if not indicated, to 60 psig.
4. Coordinate installation of ASME rated safety relief valves with boiler manufacture.

R. Safety Relief Valve:

1. Install safety relief valves at hot-water boilers, hot-water converters and elsewhere as required by ASME Boiler and pressure Vessel code.
2. Refer to heating system boiler specifications and capacity for sizing and mounting of safety relief valve.
3. Safety relief valve to be located at the boiler, and sized at a higher pressure and temperature rating than pressure relief valve.

S. Glycol Makeup Units:

1. Install glycol makeup unit in location as shown on the plans, details and/or schedules.
2. Provide full sized isolation valves for service.

T. Water Filters:

1. Install type of water filter in location as shown on the plans, details and/or schedules.
2. Install drain piping with ball valve; extend full size to nearest floor drain.
3. Provide full sized isolation valves for service.

U. Strainers:

1. Provide strainers on inlet side of each control valve, pressure-reducing valve, pump and elsewhere as indicated. Install blow down valve same size as blow down connection.
2. Provide 20 mesh start-up screens at pump strainers and basket strainers removed prior to test and balance and utilize operating screens.
3. Provide the following operating screens for water systems:
 - a. Upstream of control valves:
 - 1) 20 mesh for pipes sizes from ½" to 2".
 - 2) 3/64" perforations for pipe sizes from 2-1/2" to 3".
 - 3) 1/8" perforations for pipe sizes 4" and above.
 - b. Upstream of pumps:
 - 1) 3/64" perforations mesh for pipes sizes from ½" to 2".
 - 2) 1/8" perforations for pipe sizes from 2-1/2" to 3".
 - 3) 5/32" perforations for pipe sizes 4" and above.

4. Pump suction diffusers without strainer screens and baskets may be used in lieu of a suction pipe requirement of 5 pipe diameters and strainer for pumps.
 - a. Verify suction diffuser screens are removed.
 - b. Verify Y strainer upstream of pump is installed.
 5. Pump strainers: Pipe full size from blow down valve to nearest floor drain.
- V. Provide blow down valve with hose end thread connection and chained cap when blow down is not piped to drain
- W. Flexible Hose Connector:
1. Coordinate application with Vibration Isolation specifications.
 2. Flexible hose connectors are to be installed on the equipment side of shut-off valves.

END OF SECTION 232117

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related sections include the following:
 - 1. Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 2. Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
 - 3. Division 23 Section "Hydronic Piping".
 - 4. Division 23 Section "Hydronic Piping Specialties" for pump specialty fittings.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Flexible long coupled, end-suction base-mounted centrifugal pumps.
 - 2. Close coupled, vertical-mounted, in-line centrifugal pumps.

1.3 PERFORMANCE REQUIREMENTS

- A. Products shall be suitable for piping system fluids, materials, pressures, and temperatures.
- B. Pumps and installation shall withstand the minimum design pressure and temperature and test pressure as specified in Hydronic Piping.

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each pump.
 - 2. Unit dimensions, weight and appropriate identification.
 - 3. Indicate operating point on pump curves. Pump curves shall include a series of curves indicating the relationship of flow and pressure for various impeller dimensions. For variable speed pumps, provide additional pump curves which include a series of curves indicating the relationship of flow and pressure for impeller provided a various RPMs.
 - 4. Motor ratings, RPM, electrical characteristics and motor accessories.
 - 5. For multiple pumps operating in parallel, provide pump curves show performance of all operating pumps in parallel and performance of single operating pump.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Listed and labeled per requirements of UL and UL Canada.
- C. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- D. Hydraulic Institute Compliance: Applicable requirements in referenced Standards.

1.7 DESIGN CRITERIA

- A. Pump types, sizes, capacities, pressure and operating characteristics shall be as shown on the plans and/or as scheduled.
- B. Pumps shall meet or exceed the operating efficiencies scheduled at design conditions.
- C. Pumps shall meet the flow scheduled and meet or exceed the head scheduled.
- D. For constant speed pumps, impeller size shall be the largest non-overloading impeller for the size of the pump motor scheduled.
 - 1. For pumps greater than 2 HP, furnish each pump with one spare impeller. The spare impeller size shall also be the largest non-overloading impeller for the size of the pump motor scheduled. Contractor to trim impeller coordinated with TAB per Part 3 specifications.
- E. For pumps with VFD's, impeller size shall be the largest non-overloading impeller for the size of the pump motor scheduled.
- F. Furnish all pumps complete with motors, impellers, drive assemblies, bearings, coupling guard where required and accessories as hereinafter specified.
- G. Select motor with sufficient horsepower rating for non- overloading operation over the entire pump curve.
- H. Provide inverter duty motors with shaft grounding devices for all motors used with Variable Frequency Drives.
- I. Furnish each pump and motor with a name plate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current.
- J. Test all pumps, clean and paint before shipment.
- K. All pumps shall operate without objectionable noise or vibration.
- L. Furnish suitable for the installation, standard internally or externally flushed mechanical seals. For fluids with abrasive characteristics or when shown on the drawings , manufacturer to upgrade seals to carbide seals or an externally flushed stuffing box with packing type designs with sediment separator furnished on the external flushing line to meet duty. Provide drip pan and drain for stuffing box designs.
- M. Furnish one spare seal and casing gasket for each pump to Owner.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Retain protective covers for flanges and protective coatings during storage.
- C. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

1.9 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Pumps and installation shall be suitable for indicated service with design pressure and temperature ratings as indicated in Part 1 "Performance Requirements" Article.
- B. Pumps and installation shall withstand 1.5 times the system's working pressure for pressure test requirements.
- C. Finish: Manufacturer's standard paint finish.
- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong Pumps Inc.
 - 2. Aurora Pump; Division of Pentair Pump Group.
 - 3. Bell & Gossett.
 - 4. PACO.
 - 5. Patterson
 - 6. Peerless Pump; a Member of the Sterling Fluid Systems Group.
 - 7. Taco, Inc.
 - 8. Weinman; Div. of Crane Pumps & Systems.
 - 9. Grundfos.

2.2 FLEXIBLE LONG COUPLED, END-SUCTION BASE MOUNTED CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and tested, centrifugal, overhung-impeller, flexible long coupled, end-suction three piece backpull out pump mounted on a structural base with motor, pump and motor shafts horizontal. Minimum rating for pump of 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
- B. Pump Construction:
 - 1. Casing: Radially split, cast iron, with wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide back pullout design with integral mount on volute to support the casing to allow

- removal and replacement of bearing, seals and impeller without disconnecting piping or motor or requiring the realignment of pump and motor shaft.
 - 2. Impeller: Cast bronze or stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - 3. Pump Shaft: Stainless steel.
 - 4. Mechanical Seal: Internally or externally flushed standard mechanical seals. Standard seals to be synthetic rubber bellows with seat gasket, stainless steel spring and of a carbon ceramic design, unless upgraded seals are required for duty.
 - 5. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
- C. Shaft Coupling: Flexible and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor. Synthetic rubber coupling sleeve for variable-speed applications.
- D. Coupling Guard: OSHA approved; steel; removable; attached to mounting frame.
- E. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM channels and angles with provisions for grouting. Factory fabricated to mount pump casing, coupling guard, and motor.

2.3 CLOSE-COUPLED, VERTICAL, IN-LINE CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, in-line pump with motor, motor/pump shaft mounted vertically. Minimum rating for pump of 175-psig minimum working pressure and a continuous water temperature of 225 deg F.
- B. Pump Construction:
- 1. Casing: Radially split, cast iron, with wear rings, threaded gage tappings at inlet and outlet, drain plug and threaded or flange connections.
 - 2. Impeller: Cast bronze or stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
 - 3. Motor/Pump Shaft: Steel with bronze sleeve or stainless steel.
 - 4. Mechanical Seal: Internally or externally flushed standard mechanical seals. Standard seals to be synthetic rubber bellows with seat gasket, stainless steel spring and of a carbon ceramic design, unless upgraded seals are required for duty.
 - 5. Motor/Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor and efficiency requirements for motors as specified in Common Motor Requirements for HVAC equipment specifications.
- B. Single phase motors to include integral thermal overload protection.

2.5 ELECTRICAL

- A. Pumps shall be supplied with NEMA motor controllers, means of disconnect and overcurrent protection in accordance with mechanical, control and electrical specifications.
- B. Disconnect Switch: Nonfusible type factory mounted. Locate within motor compartment for exterior applications, factory wired to motor.
- C. Furnish each variable speed three phase motor with field mounted variable frequency drive, VFD, with bypass, circuit breaker or fused disconnect switch, transformers, and all necessary motor starter, contactor and overcurrent protection. Locate remotely in an enclosed location for exterior applications.
- D. Furnish each constant speed three phase motor with field mounted fusible combination motor starter/disconnect switch, transformers, and all necessary motor starter, contactor and overcurrent protection. Locate remotely in an enclosed location for exterior applications.
- E. Direct Drive Speed Controller – Manually adjustable type for constant volume operation and automatic modulating or two speed type for automatic control suitable for PSC or ECM single phase motors

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Compliance: In accordance with approved submittals and manufacturer's written installation instructions.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. For pumps not supported by the floor, install continuous-thread hanger rods and isolating hangers of sufficient size to support pump weight. Suspend pump independently of piping. Fabricate brackets or supports as required. Provide vibration isolators as shown on the drawings or as specified
- E. Set base-mounted and foot mounted pumps on vibration isolator inertia base or housekeeping pad as shown on the drawings or specified.
 - 1. Install pumps and supports level.
 - 2. Install frame mounted flexible couple pumps with grout.

3.3 ALIGNMENT

- A. Align base mounted pump couplings in accord with manufacturer's written instructions.
- B. Support pump baseplate with metal shims or wedges to provide a gap for grouting the baseplate.
- C. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves and accessories that are same size as the pipe run to the pump. When pump connection size and pipe size indicated are not identical, provide necessary concentric reducers/increasers for vertical piping at the pump connection and eccentric reducers/increasers for horizontal piping. Eccentric reducers/increasers shall be installed with the top of the pipe level. All valves and piping specialties are to the full pipe size as indicated on the drawings.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install valves, gauges, flexible connectors, and associated appurtenances on suction and discharge side of pumps as indicated by the drawings.
- F. Impeller trimming: for centrifugal pumps greater than 2 HP without adjustable frequency drives, coordinate with the test and balance contractor to determine the amount of impeller trimming required after the system is balanced.
 - 1. The impeller shall be trimmed so that the pump will provide 110% of design flow with the balancing valve at the pump wide open.
 - 2. After trimming, the balancing valve shall be adjusted to provide the designed flow rate. It is acceptable to trim the spare impeller and install it in the pump and use the original impeller as the spare.
 - 3. The impeller left for the Owner as a spare shall not be trimmed.
- G. For pumps on adjustable frequency drives, adjust VFD to provide the design flow rate without trimming impeller.
- H. Install electrical connections for power, controls, and devices.

3.5 FIELD QUALITY CONTROL

- A. Perform test, inspections and prepare test reports including:
 - 1. Verify that unit is secure on supporting devices and that connections to piping and electrical systems are complete.
 - 2. Verify that proper thermal-overload protection is installed in motors, controllers, electric heaters and switches.
 - 3. Verify proper motor rotation direction.
 - 4. Verify that bearings are lubricated with factory-recommended lubricants.

5. Verify piping systems are clean and purged of air.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, and equipment installation and to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Check piping connections for tightness.
 3. Clean strainers on suction piping.
 4. Perform the following startup checks for each pump before starting:
 - a. Verify bearing lubrication.
 - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 5. Prime pump by opening suction valves and closing drains and prepare pump for operation.
 6. Vent air from top of pump volute for horizontally mounted pumps.
 7. Measure and record motor electrical values for voltage and amperage and compare to nameplate and motor overloads.
- C. Pump will be considered defective if unit or components do not pass test and inspections.
- D. Prepare and submit inspection, test and startup reports. Make necessary corrections and repeat test and inspections.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to assist in training Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes refrigerant piping and installation for air-conditioning applications.
- B. This section includes the field installation of compressors, condensers, coils, condensing units, and all other fittings, devices, and accessories required to complete the refrigeration systems as shown on the drawings.
- C. For detailed installation instructions, refer to the manufacturer's installation manuals. The contractor shall provide all necessary piping, refrigerant, and accessories required for a complete operating system.
- D. This contractor is responsible for unloading, assembling, and installing all equipment and specialties.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-134A:
 - 1. Suction Lines for Air-Conditioning Applications: 115 psig.
 - 2. Suction Lines for Heat-Pump Applications: 225 psig.
 - 3. Hot-Gas and Liquid Lines: 225 psig.
- B. Line Test Pressure for Refrigerant R-402B, R-404A, R-507,R-407C:
 - 1. Suction Lines for Air-Conditioning Applications: 230 psig.
 - 2. Suction Lines for Heat-Pump Applications: 380 psig.
 - 3. Hot-Gas and Liquid Lines: 380 psig.
- C. Line Test Pressure for Refrigerant R-410A, R-454B and R-32:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Liquid Lines: 535 psig.

1.4 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include refrigerant valves and piping specialties in maintenance manuals. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
 - 6. Pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: 1/4 inch equals 1 foot.
 - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.50.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Brazing Filler Metals: AWS A5.8 Class BCuP-5
- E. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 - 3. Operator: Rising stem and hand wheel.
 - 4. Seat: Nylon.
 - 5. End Connections: Socket, union, or flanged.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
 - 1. Body and Bonnet: Forged brass or cast bronze.
 - 2. Packing: Molded stem, back seating, and replaceable under pressure.
 - 3. Operator: Rising stem.
 - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 - 5. Seal Cap: Forged-brass or valox hex cap.
 - 6. End Connections: Socket, union, threaded, or flanged.
 - 7. Working Pressure Rating: 500 psig.
 - 8. Maximum Operating Temperature: 275 deg F.
- C. Service Valves (Shrader Valve):
 - 1. Body: Forged brass with brass cap including key end to remove core.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.
 - 3. Seat: Polytetrafluoroethylene.

4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig.
- D. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
 6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 deg F.
- E. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig.
 6. Maximum Operating Temperature: 240 deg F.
- F. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 deg F.
 6. Balanced Port design
 7. Externally equalized
 8. Superheat: Adjustable.
 9. Reverse-flow option (for heat-pump applications).
 10. End Connections: Socket, flare, or threaded union.
 11. Working Pressure Rating: 700 psig.
- G. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 5. Seat: Polytetrafluoroethylene.
 6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
 7. End Connections: Socket.

8. Set Pressure: Adjustable
9. Throttling Range: Maximum 5 psig.
10. Working Pressure Rating: 500 psig.
11. Maximum Operating Temperature: 240 deg F.

H. Evaporator Pressure Regulators

1. Maximum rated pressure 450 psig
2. Adjustable settings up to 150 psig
3. Normally open design
4. High side pilot operation

I. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

J. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

K. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

L. Replaceable-Core Filter Dryers: Comply with ARI 710.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: Solid core molecular sieve style
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.

6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Rated Flow: Based upon equipment capacity
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

M. Permanent Filter Dryers: Comply with ARI 710.

1. Body and Cover: Painted-steel shell.
2. Filter Media: Solid core molecular sieve style.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Rated Flow: Based upon equipment capacity
9. Working Pressure Rating: 500 psig.
10. Maximum Operating Temperature: 240 deg F.

N. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

O. Receivers: Comply with ARI 495.

1. Comply with UL 207; listed and labeled by an NRTL.
2. Body: Welded steel with corrosion-resistant coating.
3. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
4. End Connections: Socket or threaded.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

P. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANTS

- A. Lines NPS 3/4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Lines NPS 1/2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Provide isolating, charging, purging check, and relief valves to allow for control, isolation, charging, excessive pressure protection and pressure monitoring of all field modified refrigeration equipment.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- D. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- E. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 1. Install valve so diaphragm case is warmer than bulb.
 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- F. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- G. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 1. Solenoid valves.
 2. Thermostatic expansion valves.
 3. Hot-gas bypass valves.
- I. Install receivers sized to accommodate pump-down charge.
- J. Install flexible connectors at compressors.

3.3 HEAD PRESSURE REGULATION (Air Cooled Condensing Units)

- A. Provide a complete head pressure regulating valve system as required for each individual refrigeration system. Install according to the manufacturer's recommendations.

3.4 SPLIT-DX SYSTEMS

- A. Install refrigerant piping and accessories as recommended by the manufacturer and this specification.

3.5 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Nitrogen must be flowed through the inside of the piping system during any brazing operations. The piping system shall be left open at one point to prevent the nitrogen from building up any pressure inside the pipe. The nitrogen must flow into and out of the piping system during brazing to displace any oxygen inside the pipe.
- C. Install refrigerant piping according to ASHRAE 15.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping adjacent to machines to allow service and maintenance.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Manufactured brazed ASME 16.50 fittings shall be used. Field fabricated mitered elbows and tees will not be allowed.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.
- M. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- N. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- O. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- P. Slope refrigerant piping as follows:

1. Piping slope shall be 2-1/2" per 20 feet to prevent oil trapping.
 2. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 3. Install horizontal suction lines with a uniform slope downward to compressor.
 4. Install traps and double risers to entrain oil in vertical runs.
 5. Liquid lines may be installed level.
- Q. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- R. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- S. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- T. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- U. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- V. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- W. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.6 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- D. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.7 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs.
 - 2. Trapeze strut hangers with vibration inserts for multiple horizontal piping
 - 3. Copper-clad hangers and supports for hangers and supports with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- D. Support multifloor vertical runs at least at each floor.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. The Contractor shall notify the Architect in advance of any test so that Owner's representatives may be present for tests if desired.
- C. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector and by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.9 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 250 micrometers. Turn off vacuum pump and isolate system. If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.

3.10 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

3.11 OPERATION AND CHECK-OUT

- A. Contractor shall be responsible for the proper adjustment of all refrigeration controls in the system, including controls on each refrigeration circuit, air temperature controls in the machine room, remote condenser controls, water regulation valves, or other related controls.
- B. The contractor shall check the compressor overload protectors with the manufacturer's specifications, and inform the Architect if they are incorrect.
- C. The contractor shall check and make any adjustments to the controls during the first 4 hours of system operation. The contractor's refrigeration mechanic shall remain on site all day during the first day of full operation of each system.
- D. Include Operation and Check-out report with close-out documents.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

- B. Related Sections include:

1. Division 23 Section "Hangers and Support for HVAC" for hangers and supports.
2. Division 23 Section "Vibration Controls for HVAC Piping and Equipment" for vibration isolation.
3. Division 23 Section "HVAC Insulation" for ductwork external insulation.
4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, fittings and hangers and supports to comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and requirements of Part 3 Articles.
- B. Structural Performance: Design duct hangers and supports and seismic restraints to withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems" and ASCE 7 as Delegated Design.
- C. Comply with applicable SMACNA Standards.

- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- G. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- H. All system products provided for this project shall conform to NFPA Section 90A and possess a flame spread rating of not over 25 and a smoke developed rating no higher than 50.
- I. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Double-Wall manufactured ductwork
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
- B. Shop Drawings: Completely coordinated with all other trades and include:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Double line duct layout drawings indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top and bottom of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including all dampers (manual, control, fire/smoke), turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
 - 13. Unresolved conflicts between trades shall be clearly noted.
- C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports and, as applicable, seismic restraints.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 GENERAL

- A. All manufactured ductwork and fittings shall be manufactured by a company whose primary business is single wall spiral duct and fittings who has been in business for ten (10) years, minimum.
- B. All ductwork shall be minimum 26 gauge. Minimum 26 gauge is required to meet many building code exceptions for duct and transfer openings in assemblies required to be protected. Heavier gauge may be required for specific duct systems listed in this section or as required by SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA Standards suitable for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, duct reinforcement and other provisions in SMACNA Standards.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA Standards suitable for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, duct reinforcement and other provisions in SMACNA.

- D. Fittings: Select according to requirements of the drawings and specifications of similar construction to match duct system.

2.3 SINGLE-WALL MANUFACTURED ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Lindab Inc.
 - 2. McGill AirFlow LLC
 - 3. SEMCO Incorporated
 - 4. Lewis & Lambert
 - 5. Crown
- B. Duct shall be machine formed round and/or flat oval spiral lock seam duct or longitudinal seam duct constructed of galvanized steel as specified suitable for pressure class specified. Use manufactured duct and fittings as indicated on the drawings and as required in accordance with manufacturer's published data.
- C. The use of lighter gauge single rib ductwork is not allowed.
- D. The use of snap lock ductwork is allowed for run out ducts as indicated in part 3. The use of adjustable segmented elbows is allowed for run out ducts as indicated in part 3.
- E. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," based on indicated static-pressure class unless otherwise indicated.
- F. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- G. Transverse Joints: Select slip or flange joint types and fabricate according to SMACNA Standards suitable for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, duct reinforcement and other provisions in SMACNA Standards.
 - 1. Transverse Joints in round ducts larger than 30 Inches in Diameter: Flanged.
 - 2. Transverse joints in flat oval ducts larger than 24" minor or 42" major dimension: Flanged.
 - 3. Transverse joints in round ducts up to 20 inches in diameter: O-ring Seals.
- H. Longitudinal Seams: Utilize butt-welded seams fabricated according to SMACNA standards suitable for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, duct reinforcement and other provisions in SMACNA Standards. Fabricate round ducts larger than 84 inches in diameter with longitudinal seam ductwork. Fabricate flat-oval ducts larger than 77 inches in width (major dimension) with longitudinal seam ductwork.

- I. Spiral Seams: Utilize spiral lock seams fabricated according to SMACNA Standards suitable for static-pressure class, applicable sealing requirements, materials involved, duct support intervals and other provisions in SMACNA Standards.
- J. Fittings: Select according to requirements of the drawings and specifications of similar construction to match duct system.

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, all thread rod, tubing or conduit sized per SMACNA Standards.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.

- d. Owens Corning.
 2. Maximum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 3. For interior applications, liner thickness shall be 1 inch. For exterior applications, liner thickness shall be 2 inches.
 4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial, fungicidal coating shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems. Coating shall meet ASTM D 5590 with 0 growth rating. Coating shall be Foster Products 40-20 or approved equal.
 5. Liner to be suitable for rectangular ducts with air velocities up to 4000 fpm. and temperature to 250 deg F.
 6. Solvent or Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916, Type II.
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.
 - c. K-Flex USA.
 2. For interior applications, liner thickness shall be 1 inch. For exterior applications, liner thickness shall be 2 inches.
 3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B
- C. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" And manufacturer's instructions.

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- A. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 70 percent by volume.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Non-Fibrated.
 6. Mold and mildew resistant.
 7. VOC: Maximum 75 g/L (less water).
 8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 9. Service: Indoor or outdoor.

10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- B. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- C. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- D. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- B. Hanger Rods for Corrosive Environments: Use stainless-steel or fiberglass hangers and supports for corrosive service. Use square nuts made of vinyl ester or hex nuts made of polyurethane or stainless steel.
1. Use vinyl ester resin fiberglass for "ozone" applications.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Steel Cables for Galvanized-Steel Ducts: Aircraft quality zinc coated galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Aircraft quality stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated or Zinc Cast steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. For cable connection systems, provide rubber pads to prevent air leakage at duct connections.

- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
- I. Building Attachment: Galvanized steel or equal corrosion resistant metal suitable for attachment to structure: concrete inserts, beam clamps, concrete anchors and welded studs. Powder-actuated fasteners may be applied if allowed by seismic constraints.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Install ducts, hangers and supports according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless the Contract Documents include more stringent requirements.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Utilize elbows, branch connections and other fittings of the type as shown on the drawings and as specified. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- C. Comply with mounting and anchoring requirements for seismic installations.
- D. Install round and flat-oval ducts in maximum practical lengths.
- E. Install ducts with fewest possible joints.
- F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- H. Install ducts close to walls, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness. Maintain a clearance of 6 inches, for rated walls.
- J. Install ducts as close as possible to underside of beams and joists.
- K. Route ducts to avoid passing through electrical rooms and technology rooms.

- L. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- M. Install all control dampers, fire dampers, smoke dampers and fire smoke dampers. Comply with requirements in Division 23 Section "Air Duct Accessories".
- N. Use splitter dampers and/or extractors only where manual dampers will not accomplish the intended balancing. The use of splitter dampers and/or extractors will not eliminate the need for specified or indicated manual volume dampers.
- O. Construct branch take off from duct main with a 45 degree entry fitting or conical fitting. Square edge 90 degree take off fittings, including spin in connections, will not be acceptable.
- P. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius elbow is required, provide short radius elbow with full length splitter vanes or mitered elbow with turning vanes.
- Q. Rectangular Duct – Elbow and Tee Configuration: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Radius with minimum 1.5 radius-to-diameter ratio.
 - 2. Short radius with full length splitter vanes Type RE 3
 - 3. Mitered with single wall turning vanes Type RE2 .
- R. Round and flat oval Duct – Elbow and Tee Configuration: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Radius type with minimum 1.5 radius-to-diameter ratio.
 - 2. Mitered type by duct manufacturer with single wall turning vanes.
 - 3. Adjustable segmented type elbows up to 16 inch may be used for run out ducts to air inlets and outlets.
 - 4. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
- S. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: 5 piece gored Welded.
- T. When specified in part 2, snap lock ductwork is allowed for run out ducts to air inlets and outlets up to 16 inches. The use of adjustable segmented elbows is allowed for run out ducts to air inlets and outlets up to 16 inches. All longitudinal and transverse seams shall be sealed with duct sealant and additionally secured with sheet metal screws. Snap lock construction will not be accepted on aluminum ductwork.
- U. Utilize external reinforcements, tie rods and hangers unless size of duct requires internal tie rods.
- V. All duct hanger straps are required to be screwed to rectangular duct.

- W. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines" exceeding SMACNA's advanced level of cleanliness.
- X. Where two different metal ducts meet, the joint shall be installed to prevent metal to metal contact by using proper seal or compound.
- Y. Outside air intake ducts shall pitch to intakes and drain to outside of building. Provide water tight joints and seams. Blank off all unused portions of louvers with 2 inch board insulation with galvanized sheet metal backing on both sides.
- Z. All return air openings above ceilings shall be provided with a ½" mesh aluminum screen.
- AA. For exterior ductwork, pitch top of duct to prevent water from pooling on top of duct.
- BB. Provide negative pressure relief fittings downstream of all closer devices and as shown on the plans and/or details (i.e., control fire, combination fire/smoke dampers, etc.).
- CC. Provide duct accessories included access doors, manual dampers, control dampers, flexible ductwork, flexible connectors, relief doors per Division 23 Section "Air Duct Accessories".

3.2 ADDITIONAL INSTALLATION REQUIREMENTS OF MANUFACTURED DUCTWORK

- A. Construct duct and fittings with reinforcements in accord with the manufacturer's published data and SMACNA. Remove internal shipping braces if provided.
- B. Utilize manufacturer's slip type or flanged connectors to connect duct. Connectors shall fit tight to the inner duct wall without projecting into the duct air stream.
- C. All takeoffs or branch connections shall be provided by the duct manufacturer.
- D. Seal slip joint with duct sealant and secure with sheet metal screws.
- E. Utilize flanged connectors for duct sizes requiring reinforcement and for flat oval ducts to prevent sagging.
- F. Seal flanged connectors with approved gasketing and secure flanges with nuts and bolts.
- G. Install O-ring joints per manufacturer's requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR BATH OR SHOWER EXHAUST DUCT CONSTRUCTION

- A. All associated exhaust ductwork shall be air and water tight by means of externally welded, ground and polished joints and seams. Welded seam shall be located at one of the top corners of the duct.
- B. For bathrooms with only one shower or bath, the branch runout to the exhaust grille shall be aluminum. Sealant may be used in lieu of welding for these branches.
- C. For single hotel room bathroom exhaust, the branch runout to the exhaust grille may be galvanized steel.

3.5 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to be welded or shall have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and other Division 23 specification sections.
- B. Hanger and support Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," for maximum hanger and support spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.

- E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 PAINTING

- A. Paint interior of metal ducts and plenums that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 FIELD QUALITY CONTROL

- A. Perform visual inspections of installed ductwork to assure that there are no gaps or leaks which would degrade system performance.
- B. Perform duct leakage tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." with the allowable leakage values summarized in the table below. Submit a test report for each test.

Duct Pressure Class - P	½", 1", 2" wg	3" wg	4", 6", 10" wg
Leakage Class (CFM per 100 Sq. Ft.. of Duct Surface Area), $F_{leakage} = CL \times P^{.65}$			
Rectangular Metal (CL)	24	12	6
Round Metal (CL)	12	6	3

- 2. Test the following systems:
 - a. Supply Ducts with a Pressure Class of 2-Inch wg or 3-Inch wg: Test representative duct sections from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class in each system.
 - b. Supply Ducts with a Pressure Class of 4-Inch wg or Higher: Test 100 percent of total installed duct.
 - c. Return, Exhaust, and Outside Air Ducts with a Pressure Class of 2-Inch wg or higher: Test representative duct sections from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class in each system.
 - d. Test all vertical shafts located inside the building envelope and all supply and return ducts located outside of the building envelope (across the roof, attics, mechanical rooms vented to the outside etc.) regardless of pressure class.
 - e. Test grease duct systems as required by the local code enforced.
 - f. Test smoke control system ductwork at 1.5 times the static pressure of the system. Test 100 percent of total installed duct.

3. Duct leakage tests shall be performed while duct sections are being installed prior to installation of external insulation and finished ceilings.
4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
5. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
6. Conduct leakage testing of ductwork at pressure rating of the duct section, positive pressure or negative pressure as specified. Increase air flow from leakage test fan gradually to prevent over pressurization of ducts. The leakage amount shall not exceed the allotted Leakage Class amount for that portion of the system.
7. Do not pressurize systems above maximum design operating pressure.
8. If excessive air leakage is found during leakage testing, locate leaks, seal, repair and repeat Leakage Test.
9. For Life Safety/Smoke Control systems: If the systems are not testing within the tolerances for leakage, repair and seal the ducts to pass the Leakage Test or utilize a product some to Aeroseal to seal the ductwork system.

3.9 DUCT CLEANING

- A. Ductwork shall be installed with cleanliness that exceeds SMACNA's Advanced Duct Cleanliness Level as defined in SMACNA's "Duct Cleanliness for New Construction Guidelines."
- B. Use duct cleaning methodology as indicated in NADCA ACR.
- C. Clean ductwork internally of dust and debris, unit-by-unit as it is installed. Clean external surfaces of foreign substances which might cause corrosive deterioration of the facing.
- D. Clean exposed duct systems of all dust, debris, foreign substances, and shop fabrication identification marks or stickers. Refer to Architectural requirements for painting of exposed duct systems.
- E. Provide temporary duct closures of polyethylene film or other covering to prevent the entrance of dust and debris until the time connections are completed.

3.10 DUCT SCHEDULE

A. Fabricate ducts as indicated in the following table:

	Galvanized Sheetmetal	Aluminum Sheet	Stainless Steel Sheet	Black Steel (Uncoated)	Fiber Duct Board	Flexible Duct	REMARKS
Mixed Air Duct & Plenum "interior"	X						
Supply, Return, Exhaust & O.A Ducts "interior"	X						
Supply, Return, Exhaust & O.A. Ducts "exterior"	X		Opt.				
Supply/Return/Exhaust Branch Run-outs "Interior"	See Remarks					X	Refer to details. Sheet metal is required for critical care applications in Healthcare Facilities Exposed ductwork in front of house locations shall be double wall
Transfer Ducts "interior"	See Remarks				X		Refer to details. Sheet metal is required for Healthcare Facilities Refer to Division 23 Section "Nonmetal Ducts" for duct board requirements.
Underground Ducts							Refer to Division 23 Section "Nonmetal Ducts"
Humidifiers/Clg. Coils			X				
Ducts in Corrosive environments			X				
Decontamination washer, Autoclave and Sterilizer branch exhaust duct.		X.	Opt				
Shower Branch Exhaust		X	Opt.				
Dryer Exhaust Duct	X						
Dishwasher, group showers or other "wet" Exhaust Systems		Opt.	X				
Kitchen Exhaust Ducts (Exposed or Exterior)			X				
Kitchen Exhaust Ducts (Concealed)			Opt.	X			

B. All ducts shall have a Seal Class of A, regardless of pressure class, unless noted otherwise.

C. Unless otherwise indicated on the drawings or specifications, construct all ductwork for a minimum pressure class equivalent to the positive or negative static pressure at the fan entrance or discharge, or for a 2 inch w.g. pressure class, whichever is greater.

1. Ductwork from air handling unit discharge connection to the inlet connection at the air terminal device or reheat coil shall be constructed to a minimum of 4" w.g. positive pressure class.
2. Ductwork downstream of the air terminal device or reheat coil shall be constructed to a minimum of 2" w.g. positive pressure class.

3. Return, exhaust and outside air ductwork shall be constructed to minimum of 2" w.g. negative pressure class
- D. Duct Reinforcement: Provide duct bracing to meet pressure class per SMACNA Standards.
 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
 2. Stainless-Steel Ducts: Match duct material.
 3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
 4. Flat Oval Ducts: Reinforce negative pressure ducts in accordance with SMACNA's requirements for rectangular duct systems.

3.11 DUCT LINER DUCT

- A. Duct liner duct is required to reduce noise levels or for appearance when exposed.
- B. Apply lining to the following ductwork:
 1. All air transfer ducts unless ductboard is acceptable by Division 23 Section.
 2. Supply and return ductwork 10 feet from unit connections for air handling units 1000 cfm or greater.
- C. Lined ducts do not require external insulation, unless indicated otherwise.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Backdraft and barometric dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Flexible ducts.
9. Runout duct fittings
10. Duct accessory hardware.

- B. Related Sections include:

1. Division 23 Section "Instrumentation and Control for HVAC".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Air pressure drop scheduled includes both catalog and system effect pressure loss of the silencer. Submittal pressure drops to include system effect factors based upon the inlet and discharge conditions. Include breakout noise calculations for high transmission loss casings.

- B. Shop Drawings: Coordinate with ductwork specifications.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances, and method of field assembly into duct systems and other construction. Include the following:

- a. Special fittings.
- b. Manual volume damper installations.
- c. Control damper installations.
- d. Fire damper, ceiling, including sleeves; and duct-mounted access doors and remote damper operators.
- e. Duct silencer installation including distance to duct fittings
- f. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material of product shall match ductwork material.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 BACKDRAFT AND BAROMETRIC DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Air Balance Inc.; a division of Mestek, Inc.

2. Greenheck Fan Corporation.
 3. Nailor Industries Inc.
 4. Pottorff; a division of PCI Industries, Inc.
 5. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Minimum Pressure Rating: 2-inch wg or pressure rating of ductwork whichever is greater.
- E. Frame: 0.052-inch-thick, galvanized sheet steel, 0.063-inch-thick extruded aluminum or 0.052-inch-thick stainless steel, with welded corners and mounting flange to match ductwork material.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl or polyurethane, mechanically locked.
- I. Blade Axles:
1. Material: Stainless steel .
 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Barometric Damper Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
 2. Counterweights and spring-assist kits for vertical airflow installations.

2.3 MANUAL VOLUME DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
 2. Greenheck.
 3. McGill AirFlow LLC.
 4. METALAIRE, Inc.
 5. Nailor Industries Inc.

6. Pottorff; a division of PCI Industries, Inc.
 7. Ruskin Company.
 8. VentLock
- B. Standard leakage rating, with linkage outside airstream.
- C. Suitable for horizontal or vertical applications.
- D. Frames:
1. Hat-shaped, channels, 0.052-inch-thick, galvanized sheet steel, 0.063-inch-thick extruded aluminum or 0.052-inch-thick stainless steel to match the material of the duct in which they are installed.
 2. Mitered and welded corners.
 3. Flanges for attaching to walls and flangeless frames for installing in ducts.
- E. Blades:
1. Multiple blade for ducts over 12 inches in height.
 2. Single blade for ducts up to 12 inches in height.
 3. Parallel- or opposed-blade design.
 4. Stiffen damper blades for stability and to prevent vibration, flutter, or other foreign noise.
 5. Minimum 22 ga. thickness in the same material as the duct the damper is installed.
- F. Blade Axles: the same material as the duct the damper is installed.
- G. Bearings:
1. Molded synthetic.
 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
- H. Tie Bars and Brackets: same as duct material.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
 2. Greenheck.
 3. Nailor Industries Inc.
 4. Pottorff; a division of PCI Industries, Inc.
 5. Price
 6. Ruskin Company.

- B. Dynamic type fire dampers, meeting the requirements of the latest edition of UL Standard 555, suitable for application in dynamic or static HVAC systems. Provide dampers for vertical or horizontal as appropriate for the installation.
- C. Provide stainless steel construction when mounted in stainless steel or aluminum duct systems.
- D. Dynamic closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- E. Fire Rating: 1-1/2 and 3 hours, compatible with assembly being installed in.
- F. Curtain Type
 - 1. Frame: Integral frame constructed of 16 gage roll formed galvanized steel. Provide duct fire dampers with factory mounted wall mounting sleeve of length suitable for wall type.
 - 2. Blades: Curtain type with spring closure upon fusible link release. Type B dampers with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, minimum 24 gage roll formed, galvanized steel. Type 301 stainless steel closure springs when required.
 - 3. Mounting Sleeve: Factory-installed, 20 gage, or duct thickness whichever is greater, thick, galvanized sheet steel; length to suit wall or floor application including out of wall applications.
 - 4. Heat-Responsive Device: Replaceable, 165 deg F unless specifically identified to be 212 deg F rated, fusible links.
 - 5. Accessories:
 - a. Field or factory furnished mounting angles including manufacturer one sided angle.
 - b. Steel mullions for dampers in oversized masonry wall openings.
 - c. Provide sleeve and insulating material to allow for out of wall installation with damper up to 8" out of plane of wall or floor as required for the application.
- G. Multiblade Type
 - 1. Triple V-groove blades for 1 ½ hour fire rating to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.
 - 2. Air foil blades for 3 hour fire rating to 8-inch wg static pressure class and up to 4000-fpm velocity.
 - 3. Frame: Integral frame constructed of 16 gage roll formed galvanized steel hat shaped channel, reinforced at corners. Provide duct fire dampers with factory mounted wall mounting sleeve of length suitable for wall type.
 - 4. Blades:
 - a. V-groove blades single skin with 3 longitudinal grooves constructed of minimum 16 gage galvanized steel. ACMA tested for ducted configuration with maximum air pressure drop of 0.20 inches w.g. at 2000 fpm through 24 X 24 damper assembly
 - b. Airfoil- shaped, single-piece of minimum 14 gage equivalent thickness, galvanized steel. ACMA tested for ducted configuration with maximum air pressure drop of 0.10 inches w.g. at 2000 fpm through 24 X 24 damper assembly
 - 5. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.

6. Linkage: Concealed in frame with minimum ½ inch diameter plated steel axles mechanically attached to blade with spring closure upon fusible link release.
7. Mounting Sleeve: Factory-installed, 20 gauge, or duct thickness whichever is greater, thick, galvanized sheet steel; length to suit wall or floor application including out of wall applications.
8. Heat-Responsive Device: Replaceable, 165 deg F unless specifically identified to be 212 deg F rated, fusible links.
9. Accessories:
 - a. Field or factory furnished mounting angles including manufacturer one sided angle.
 - b. Steel mullions for dampers in oversized masonry wall openings.
 - c. Provide sleeve and insulating material to allow for out of wall installation with damper up to 8" out of plane of wall or floor as required for the application.
 - d. When indicated on plans, two position indicator switches linked directly to damper blade for position indication.

2.5 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Vane Construction: Single wall for ducts up to 24 inches wide and double wall for larger dimensions.

2.7 DUCT-MOUNTED ACCESS DOORS

- A. General: Fabricate access doors according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Provide pressure relief type per Part 3 requirements.
- B. Duct Access Door
 - 1. Door:
 - a. Double wall, rectangular or round.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
 - e. All exposed duct, regardless of size, requires hinges.

2.8 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide fire rated products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. 3M.
 - 3. Milcor Fire-Rated Access Doors by Greenheck.
 - 4. Milcor Fire-Rated Access Doors by Inryco, Inc.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon or 0.0428-inch stainless steel to match duct.
- D. Fasteners: Carbon or Stainless steel, to match duct. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.9 FLEXIBLE CONNECTERS

- A. Materials: Flame-retardant or noncombustible fabrics.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Metal-Edged Connecters: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- F. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 oz./sq. yd..
 - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.10 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
 2. Thermaflex
- B. Constructed from materials with flame spread index of 0-25 and a smoke developed index of 0-50 (25/50 rating) when tested in accordance with ASTM E84 (UL723), *Standard Test Method for Surface Burning Characteristics of Building Materials*. Factory-fabricated, suitable for pressures and temperatures to which duct system will be exposed and installed in accordance with the conditions of their UL listing. Tested in accordance with Sections 7 to 23 of the *Underwriters Laboratories Standard for Factory-Made Air Ducts and Air Connectors*, UL-181 Class 1 unless otherwise specified. Installed in accordance with *Air Diffusion Council (ADC) Flexible Duct Performance + Installation Standards*, 5th Edition, Chapter4, Installation Requirements.
- C. Pressure rating of flexible duct, 6 inch w.g. positive, 1 inch w.g. negative, rated for a velocity of at least 4000 fpm unless otherwise specified.
- D. Temperature rating of flexible duct, continuous operation at a temperature range of -20°F to +250°F unless otherwise specified.
- E. Insulated flexible duct shall be constructed of an inner air barrier liner supported by and mechanically locked to a helical wound galvanize steel helix without the use of adhesives or chemicals. Factory-insulate the flexible duct with fiberglass insulation with an R value of 6 minimum at a mean temperature of 75 F. Cover the insulation with a fire-retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than .05 perms when tested in accordance with ASTM E96.
- F. Acoustical Insulated, Flexible Duct: Inner air barrier liner, acoustically transparent CPE air impervious fabric, Flexmaster Type 1M, Thermaflex Type M-KE or approved equal.
1. Sound Performance: Minimum Insertion Loss for 10 foot length straight duct at a velocity of 2500 feet per minute rated in accordance with Air Diffusion Council Test Code FD 72-RI.

Octave Band	2	3	4	5	6	7
Hz	125	250	500	1000	2000	4000
6-in	11	33	37	39	37	19
8-in	13	35	34	39	29	17
12-in	10	26	26	35	24	11

G. Flexible Duct Connections:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap to match duct material and to suit duct size. Sheet metal screws will not be allowed.

2.11 RUNOUT DUCT FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following;

1. Elgen.
2. Flexmaster.
3. Sheet Metal Connectors, Inc.
4. Or approved equal

B. Description: Factory-fabricated conical fittings for sheet metal or ductboard with integral volume damper. Utilize side takeoff fittings with integral volume damper with 45 degree slope on upstream side or 45 degree slopes on upstream and downstream side when indicated on the drawings or as required by duct configuration. Utilize to connect runout ducts from diffusers and grilles to submains.

C. Construction:

1. Low leakage welded seam galvanized steel, stainless or aluminum to match the material of the duct in which they are installed.
2. Spin in construction or flanged construction with neoprene gasket.
3. Integral single damper blade, 3/8" square shaft, U-bolt, nylon bushings, 2" buildout stand-off handle with locking damper quadrant handle. Dampers to be fabricated with to prevent vibration, flutter or other noise. Stand-off handle not required for non-insulated duct systems.
4. Round outlet with rolled stiffener bead for strength and sealing runout ducts.
5. Side takeoff fittings to maintain a ratio of 1 to 1 of inlet to outlet area.
6. Overall length of fitting not to exceed 13".
7. Utilize 4" W.G. construction with or without damper as shown on the drawings when connecting to 4" pressure class duct.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft and barometric dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan or elsewhere indicated on the plans and except those specified to be by the fan manufacturer and where motor operated dampers are shown or specified to be located in the discharge ductwork.
- D. Install control dampers under the coordinating control and supervision of the control contractor as specified in Section Instrumentation and Control for HVAC, in locations indicated on the drawings, as detailed and according to manufacturer's instructions.
 - 1. Provide adequate operating clearance and access to operator.
 - 2. Dampers, individual or multiple section assemblies, must be completely square and free from racking, twisting, or bending.
 - 3. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
 - 4. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
 - 5. Provide a visible and accessible indication of damper position on the drive shaft end.
 - 6. At inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- E. Install manual volume dampers at points on supply, return, exhaust and outside air systems at all branches extending from larger ducts, including run-outs to diffusers and grilles, in addition to the dampers indicated on the plans, and as necessary to regulate the flow of air meeting the air balance requirements. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- F. Utilize runout duct fittings for runout duct to diffusers, registers and grilles where duct configuration permits, unless indicated otherwise. Fittings shall be secured and sealed to duct connections in accordance ductwork specifications.
- G. Locate volume dampers as close to main duct as possible unless indicated otherwise.
- H. Install dampers so as to not flutter or vibrate.
- I. Damper handles shall be installed with stand-off handle to be mounted exterior to insulated ducts.
- J. Attach a 24 inch long fluorescent orange plenum rated "surveyors" tape at all dampers to assist in locating dampers upon completion of installation for test and balance.
- K. Install fire dampers according to UL listing, NFPA 90A, and the manufacturer's installation instructions. Install complete with mounting collars, retaining angles, connections to ductwork and duct access doors.

1. Provide fire rating of 1 ½ hours for fire rated barriers to 2 hours and fire rating of 3 hours for 3 and 4 hour fire rated barriers. Coordinate fire rating type with project's life safety plan.
 2. Curtain-type fire damper sizes shall be based upon free area of duct, so the damper blades shall not reduce the free area of the airstream.
 3. Multiblade Fire Dampers – if a duct requiring a fire damper is larger than available multiple type B (blades out of air stream) curtain-type fire damper size, then multiblade type fire dampers shall be used. Fire damper sizes shall be sized equal to associated duct size.
 - a. Provide V-groove type for 1 ½ hour fire ratings in ducts with velocities up to 1750 FPM.
 - b. Provide airfoil type for 1 ½ or 3 hour fire ratings hour in ducts with velocities to 4000 fpm.
- L. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On upstream side of duct coils.
 2. Upstream from duct filters.
 3. At outdoor-air intakes and mixed-air plenums.
 4. At drain pans and seals.
 5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links and for inspection for combination fire/smoke dampers.
 6. At duct smoke detectors.
 7. Upstream or downstream from duct silencers.
 8. At control devices requiring inspection.
 9. Upstream of elbows with turning vanes.
 10. Elsewhere to service equipment.
- M. Install access doors with swing against duct static pressure.
- N. Provide hinged access doors or cam-latch with chain access doors in exposed applications and cam-latch type in concealed installations.
- O. Install the following sizes for duct-mounting, rectangular access doors:
1. Minimum Size: 12 by 12 inch. For smaller ducts where this size is not possible, use the largest size that fits and no smaller than a minimum 12 by 6 inches for two-hand access. For even smaller ducts where the 12 by 6 inches is not possible, use the largest size that fits one-hand or inspection access.
 2. For fire, smoke and combination fire/smoke dampers
 - a. Provide multiple access doors if required to access multiple section dampers.
 - b. If a minimum 12 by 12 inches access door cannot be installed, provide a removeable duct section.
 3. Head and Hand Access: 18 by 18 inches.
 4. Head and Shoulders Access: 20 by 20 inches.
 5. Body Access: 24 by 24 inches.

- P. Label access doors to indicate the purpose of access door. For Fire, smoke and combination fire/smoke dampers, provide labels having letters not less than 1/2 inch
- Q. Ceiling access panels shall be provided, where required, to service dampers, heaters, valves and other concealed mechanical equipment,
- R. Install flexible connectors to connect ducts to equipment containing rotating or vibrating equipment, with not less than 4-incheslength of material and in accordance with SMACNA.
- S. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- T. Connect terminal units to supply ducts directly. Do not use flexible ducts to change directions or to compensate for misalignment of inlet duct to terminal unit.
- U. When specified, connect supply diffusers, return grilles and general exhaust grilles to ducts with flexible duct clamped or strapped in place. Maximum length of flex duct shall be 5'-0".
- V. Connect flexible ducts to runout fittings, sleeves, and air devices per manufacturer's installation instructions:
 - 1. Up to 3" duct construction: 2 wraps of approved tape and draw band to secure inner core.
 - 2. Over 3" duct construction: sealer, 2 wraps of approved tape and draw band to secure inner core.
 - 3. For metal type flex additionally secure with sheet metal screws.
 - 4. For insulated flex, seal outer jacket as specified for duct insulation.
 - 5. When connecting flexible duct to round metal duct utilize metal connecting sleeve to maintain duct shape.
- W. When specified, connect bathroom exhaust and "wet" exhaust systems with non-insulated aluminum or stainless steel flexible duct clamped in place. Limit length of flex to a maximum of 24" and do not use flexible duct to change directions.
 - 1. Provide slope as specified in ductwork specifications or as noted on the plans.
 - 2. Do not use for laboratory fume hood exhaust or BSC hoods.
- X. Flexible duct is not permitted in Healthcare Facilities for critical care applications.
- Y. Supply and Return flex duct shall be insulated. Exhaust flex duct shall not be insulated unless part of an energy recovery system.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Operate fire, smoke and combination fire/smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233400 – FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Ceiling-mounted ventilators.
 - 2. Centrifugal wall ventilators.
- B. Related Sections include the following:
 - 1. Division 23 Section "Common Motor Requirements for HVAC equipment".
 - 2. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".
 - 3. Division 23 Section "Vibration Controls for HVAC".

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on sea level unless otherwise indicated.
- B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include rated capacities, furnished specialties, dimensions, weights and accessories for each fan.
 - 2. Certified fan performance curves with system operating conditions indicated. Fan curves shall include a series of curves indicating the relationship of CFM and static pressure for various RPM. Brake horsepower curves shall also be included. Indicate the design operating point clearly on the fan curves. Indicate fan brake horsepower requirement at the design operating point.
 - 3. Certified octave band fan sound-power ratings.
 - 4. Motor ratings, RPM and electrical characteristics, plus motor and electrical accessories.
 - 5. Material thickness and finishes, including color charts.
 - 6. Dampers, including housings, linkages, and operators.
 - 7. Diagrams for power, signal, and control wiring

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fans to include in operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Belts: One set for each belt-driven unit.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a testing agency acceptable to authorities having jurisdiction and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. Comply with UL-705.

1.8 COORDINATION

- A. Coordinate size and location of structural-steel support members and concrete bases where applicable.

1.9 DESIGN CRITERIA

- A. All fans shall be tested as complete units in accordance with the applicable test code of AMCA and shall be certified by AMCA.
- B. All fans with belt drives shall be provided with variable pitch V-belt sheaves for purpose of system balancing. After system is balanced, fixed pitch sheaves shall replace the variable pitch sheaves for all motors using multiple belt drives.
- C. Each fan shall be selected to maintain stable fan performance at 90% of the scheduled air flow while operating at 110% of the scheduled static pressure.
- D. Each fan and motor combination shall be selected to allow full speed operation: deliver 110% of the air quantity scheduled at 121% of the scheduled static pressure. Provide Class I, II or III fan construction for full speed operation of 110%, minimum, design RPM. The motor furnished with the fan shall not operate into the motor service factor in any of these cases. Drive efficiency shall be considered in motor selection according to manufacturer's published recommendations, or according to AMCA.
- E. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, Contractor shall submit a scaled layout of the change and system effect factor calculations, indicating increased static pressure requirements as described in AMCA. This Contractor shall be responsible for any motor, drive and/or wiring changes required as a result of duct configuration changes at fan.
- F. Where fan drives are exposed use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation. Provisions shall be made so that tachometer may be used to verify fan speed without removing the guard assembly.

- G. All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.
- H. Statically and dynamically balance all fans so they operate without objectionable noise or vibration.
- I. Fan size, fan class, wheel type, inlet type, capacity, arrangement operating characteristics and any other special requirements shall be as indicated on the plans and/or as scheduled.
- J. All fans serving a "fume" application (i.e., fume hoods) shall be completely coated internally with a two-part electrostatically applied and baked, sustainable, corrosion-resistant coating system baked phenolic coating, minimum 6 mils thick.
- K. Fan bearings shall be heavy duty grease lubricated, ball or roller type selected for a Basic Rating Life (L₁₀) of at least 80,000 hours unless otherwise indicated in the fan product section. All bearings shall be factory lubricated and equipped with standard hydraulic grease fittings and lube lines extended to the motor side of the fan.
- L. All belt-driven drive assemblies shall be factory mounted, with final alignment and belt adjustment made after installation. Fan shafts shall be turned, ground and polished steel and keyed to wheel hub. Fan Pulleys shall be Cast iron with split, tapered bushing and dynamically balanced at factory. Motor Pulleys shall be adjustable pitch. Select motor pulley so pitch adjustment is at the middle of adjustment range at fan design conditions. Belts shall be oil resistant, nonsparking, and nonstatic with matched sets for multiple belt drives. Motor mounts shall have an adjustable base. Fan and motor shall be isolated from the exhaust air stream unless otherwise indicated.
- M. All V-belt drives shall be designed for 150% of motor rating.
- N. For direct drive fans with VFDs and bypass starter, select fan to operate at or above the fan's motor speed to allow fan operation in bypass mode.
- O. Provide stainless steel fasteners to secure fan to curb.
- P. Provide solid state speed controller (SCR) with PSC motor or electrically commutated motors (ECM) for all direct drive fans with single phase motors.
- Q. Provide backdraft or motorized dampers for fans where required by the plans or specifications.
- R. Exhaust fans and attachments to structure shall be designed to conform with the wind and seismic structural loading requirements identified in "Performance Requirement".
- S. Forward curved fans may be provided when scheduled and when static pressure differential at fan is 1.5" W.G. or less.

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ACME Engineering & Mfg. Corp.
 - 2. Broan Mfg. Co., Inc.
 - 3. Carnes Company
 - 4. Greenheck Fan Corporation
 - 5. Loren Cook Company

6. Panasonic.
 7. PennBarry
 8. Twin City Fan
- B. Description: Centrifugal direct drive fans designed for installing in ceiling or wall or for concealed in-line applications.
- C. Housing: Steel, lined with acoustical insulation.
- D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- E. Grille: Plastic or Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- G. Accessories:
1. Dampers: Exhaust air discharge damper shall be counterbalanced backdraft damper.

2.2 CENTRIFUGAL WALL VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ACME Engineering & Mfg. Corp.
 2. Carnes Company
 3. Greenheck Fan Corporation
 4. Loren Cook Company
 5. PennBarry
 6. Twin City Fan
- B. Description: Wall mounted direct- or belt-driven centrifugal fans with motor out of air stream consisting of housing, wheel, fan shaft, bearings, motor, starter and disconnect switch, drive assembly, mounting base and accessories.
1. Housing: Heavy-gage, aluminum along with curb cap, windband, drain and ventilated motor compartment with removable housing. Wall mounting plate with venturi inlet cone:
 2. Wireways: Integral internal wiring conduits for all power and control wiring for fan.
 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 4. Vibration Isolation: factory installed vibration isolators for drive assembly.
- C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- D. Accessories:
1. Dampers: Exhaust air damper shall be motor operated 2 position type spring return closed: powered open spring close when fan stops.
 2. Direct Drive Speed Controller.

2.3 DAMPERS

- A. General: Provide exhaust systems with counter balanced backdraft dampers or motor operated control dampers as indicated in other Part 2 articles of this specification, as indicated on the plans and /or scheduled.
- B. Motor dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating". Exhaust air dampers shall not exceed Class I leakage ratings with a maximum leakage rate of 4 cfm per square foot at 1-inch wg pressure differential.
- C. Backdraft Dampers: For fan types indicated in this specification up to 300 CFM, leakage rate, according to AMCA 500. Exhaust air dampers up to 24" dimension with a maximum leakage rate of 40 cfm per square foot at 1-inch wg pressure differential.
- D. Provide 304 stainless steel construction when installed in air handlers with stainless steel inner liners or when shown on the plans.
- E. Motor dampers and Actuators: Comply with additional requirements in Division 23 Section "Instrumentation and Control for HVAC." Factory furnished actuators to be 24 Volt, unless noted otherwise and shall comply with the Control specification requirements and be compatible with the Control System.
- F. Motor dampers to be low leakage single skin three longitudinal groove type dampers.
 - 1. Maximum open position pressure drop shall not exceed .08" W.G. at 2000 feet per minute face velocity across a 24"X24" damper.
 - 2. Frame: Heavy gauge structural hat channel reinforced frame constructed of same material as damper to provide required rigidity for proper damper operation.
 - 3. Blades: Low leakage single skin three longitudinal groove dampers of galvanized steel with blade seals suitable for velocities to 2000 FPM at temperatures from -40 F to 200 F. Provide blade and seal designs to for class 1 leakage rating.
 - a. Blade Design: Two position applications: Use either opposed or parallel blade dampers.
 - 4. Bearings: Self-lubricating stainless steel sleeve or non-corrosive molded synthetic.
 - 5. Seals: Blade seals TPE or silicone seals mechanically attached to blades.
 - 6. Linkages and shafts: Linkages concealed in frame factory fabricated to connect damper shafts to actuator extended shaft with support brackets for shaft and actuator. Linkages and shafts to be stainless for stainless steel dampers and plated or stainless steel for galvanized steel dampers, mechanically attached to blades.

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor and efficiency requirements for motors as specified in Common Motor Requirements for HVAC equipment specifications.
- B. Single phase motors to include integral thermal overload protection.

2.5 ELECTRICAL

- A. Fans shall be supplied with NEMA motor controllers, means of disconnect and overcurrent protection in accordance with mechanical, control and electrical specifications.
- B. Disconnect Switch: Nonfusible type factory mounted. Locate within motor compartment for exterior applications, factory wired to motor.
- C. Furnish each variable speed three phase motor with field mounted variable frequency drive, VFD, with bypass, circuit breaker or fused disconnect switch, transformers, and all necessary motor starter, contactor and overcurrent protection. Locate remotely in an enclosed location for exterior applications.
- D. Furnish each constant speed three phase motor with field mounted fusible combination motor starter/disconnect switch, transformers, and all necessary motor starter, contactor and overcurrent protection. Locate remotely in an enclosed location for exterior applications.
- E. Direct Drive Speed Controller – Manually adjustable type for constant volume operation and automatic modulating or two speed type for automatic control suitable for PSC or ECM single phase motors.

2.6 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Compliance: In accordance with approved submittals and manufacturer's written installation instructions.
- B. Comply with mounting and anchoring requirements for seismic and/or wind installations.
- C. Secure fan and curb mounting assemblies to structure with positive attachments in accordance project's seismic loading requirements.
- D. Install work readily accessible for normal operation, reading of instruments (in vertical position), adjustment, service, inspection and repair. Provide access panels where indicated and required. Access panels shall be the responsibility of the respective subcontractor.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Install ducts adjacent to fans to allow service and maintenance.

- B. For fans with drain, install a drain valve with screwed cap.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete.
 - 3. Verify that thermal-overload protection is provided for motors.
 - 4. Verify that cleaning and adjusting are complete.
 - 5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 6. Adjust belt tension.
 - 7. Adjust damper linkages for proper damper operation.
 - 8. Verify lubrication for bearings and other moving parts.
 - 9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 11. Shut unit down and reconnect automatic temperature-control operators.
 - 12. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fans.

3.5 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Replace fan and motor sheaves as required to achieve design airflow. After system is balanced, replace the variable pitch sheaves with fixed pitch sheaves.
- D. Lubricate bearings.

END OF SECTION 233400

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ceiling diffusers.
 - 2. Registers and Grilles
- B. Related Sections:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 DESCRIPTION

- A. All diffuser and register locations in ceilings and walls shall be coordinated with reflected ceiling plans and electrical and low voltage plans prior to submittal and installation.
- B. Prior to submitting diffusers, registers and grilles to for review, and prior to ordering, verify the ceiling system and type of ceilings specified in each space and coordinate the air device mounting system and frame with the ceiling type indicated on the reflected ceiling plans in the architectural plan documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers for specialty products are listed under those articles. For all other diffusers, registers and grilles available manufacturers are as follows:
 - 1. Nailor Industries Inc.
 - 2. Price Industries.
 - 3. Titus.

2.2 CEILING DIFFUSERS

- A. Construct diffusers of aluminum unless otherwise indicated and provide with the frame type appropriate to the installation.
- B. Provide diffusers with air straighteners.
- C. Perforated face ceiling diffusers shall have field adjustable pattern controllers accessible through a removable or hinged face plate.
- D. Furnish round or square neck duct adapters for each unit for top connection or side connection as appropriate to the space.
- E. Accessories:
 - 1. Opposed blade volume dampers.
- F. Diffuser models, sizes and finishes shall be as shown on the plans and/or as scheduled. Unless noted otherwise, diffusers shall have a baked enamel finish with color to be selected by the Architect.

2.3 REGISTERS AND GRILLES

- A. Construct registers and grilles of aluminum unless otherwise indicated and provide with the frame type appropriate to the installation.
- B. Supply registers and grilles shall be double deflection type blades to provide for air deflection adjustment in all directions.
- C. Return and exhaust registers and grilles shall have a core of fixed blades.
- D. Furnish supply grilles complete with opposed blade volume control dampers, operable from the face.

- E. Register and grille models, sizes and finishes shall be as shown on plans and/or as scheduled. Unless noted otherwise, registers and grilles shall have a baked enamel finish with color to be selected by the Architect.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Blank-off unused portion of linear diffusers and grilles.
- E. Coordinate border and frame type with Architectural Plans.
- F. For return grilles open to a ceiling plenum provide insulated sound boot behind grille for sound control and to prevent above ceiling utilities from being visible from the occupied space.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing. END OF SECTION 233713

SECTION 234100 - AIR FILTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.3 DEFINITIONS

- A. MERV: Minimum Efficiency Reporting Value per ASHRAE 52.2
- B. Efficiency: Dust Spot Efficiency per ASHRAE 52.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of filter and rack to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide one complete sets of filters for each filter bank.
 - 2. Provide extra set of filters for each filter bank. The extra sets of filters are in addition to the filters replaced prior to owner occupancy.

1.7 QUALITY ASSURANCE

- A. Comply with applicable requirements in ASHRAE 62.1.
- B. Provide MERV rated filters which comply with ASHRAE 52.2 for method of testing and rating air-filter units.
- C. Comply with NFPA 90A and NFPA 90B.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Protect filters, housings, accessories and finishes from damage during shipping, storage, handling and installation. Deliver materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- B. The Contractor shall provide for storage in an enclosed trailer, when stored on-site and prior to building "dry-in", to prevent any damage resulting from inclement weather or construction traffic.
- C. Materials, stored or installed, found to be damaged shall be replaced with new by the Contractor, to the satisfaction of the Owner and at no additional cost to the owner.

1.9 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.10 DESIGN CRITERIA

- A. Holding frames or housings specified in this Section may be furnished by the filter manufacturers listed below, or where applicable, as part of the factory packaged air handling units.
- B. Filter holding frames shall accept Manufacturer's standard filter sizes. Systems which utilize custom size filters will not be acceptable.
- C. Filter holding frame gaskets suitable for type filters utilized to control bypass of unfiltered air.
- D. Refer to schedules on the drawings for specific filter applications, efficiencies, capacities and characteristics.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Description: Factory-fabricated, media type filters and filter housings.
- B. Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. AAF International.
 - 2. Camfil Farr.

3. Flanders/CSC Corp.
 4. Tri-Dim Filter Corporation.
 5. Purafil, Inc.
- C. Refer to individual product sections for additional specific manufacturers.

2.2 MEDIUM EFFICIENCY PLEATED FILTERS

- A. Description: MERV 8 (30%) efficiency, factory-fabricated, self –supported, extended-surface, pleated, panel-type, UL 900 listed disposable air filter with holding frames.
- B. Media: Interlaced cotton and synthetic fibers with nonflammable adhesive and anti-microbial agent application.
1. Separators shall be bonded to the media to maintain pleat configuration.
 2. Welded wire grid treated for corrosion resistance on 1" centers bonded to media on downstream side to maintain pleats.
 3. Media bonded to frame to prevent air bypass.
- C. Frame: Rigid, high wet-strength cardboard frame with diagonal support members bonded to air entering and air leaving side of pleats to maintain pleat spacing. .
- D. Filters shall be 1", 2" or 4" thick MERV 8 as scheduled.
- E. 2" and 4" thick filters, clean pressure drop not to exceed .31" at 500 fpm. Maximum air velocity rating of 600 fpm.
- F. 1" thick filters, clean pressure drop not to exceed .25" at 350 fpm. Maximum air velocity rating of 425 fpm.
- G. Rated to withstand a differential pressure up to 2.0" WG.

2.3 MEDIUM AND HIGH EFFICIENCY EXTENDED MEDIA RIGID FILTERS

- A. Description: MERV 11 to MERV 16 (60% to 95%) efficiency, factory-fabricated, self –supported, extended-surface, deep pleated, rigid panel-type, UL 900 listed disposable air filter with holding frames. High efficiency filters are filters rated MERV 14 and above.
- B. Media: Laminated microfine glass fibers with reinforcing backing with nonflammable adhesive and anti-microbial agent application.
1. Separators shall be bonded to the media to maintain pleat configuration.
 2. Media mechanically and chemically bonded to frame to prevent air bypass.
- C. Frame: Rigid, high wet-strength cardboard frame with diagonal support members bonded to air entering and air leaving side of pleats to maintain pleat spacing
- D. MERV 13 filters shall be 4" thick or as scheduled.
1. MERV 13 filters selected for a clean pressure drop less than 0.5" at 500 fpm, unless scheduled otherwise.
 2. Rated to withstand a differential pressure up to 5.0" WG
- E. Filters rated to operate up to 600 fpm.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect areas where material is to be installed. Notify the Architect of conditions which would adversely affect the installation or subsequent utilization of filters. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install filters and filter housings at locations indicated and/or specified according to manufacturer's written instructions.
- B. Position each filter housing with clearance for normal service and maintenance.
- C. Install filters in position to prevent passage of unfiltered air.
- D. For air handling systems greater than 2000 CFM, provide separate filter gage for each filter in system. This included the pre-filter and any medium efficiency, or high efficiency filters. Provide filter gage for pre-filters installed in factory air handling equipment.
- E. Install filter gage static-pressure taps upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust, level and calibrate gages.
- F. Coordinate filter and filter housing installations with ductwork, equipment, controls and associated work.
- G. Mark each filter gage with dirty filter mark and set signal flag to inform maintenance personnel when to change filters.
- H. Install filter media upon installation of equipment. Upon start up of systems, Contractor shall monitor filter pressure loss and replace media as required for the duration of construction.
- I. Filter Back Grilles: Upon completion of grille installation install filter. Undersized grilles shall be replaced to accept standard size filters. Oversized grilles shall have sheet metal filler strips installed to accept standard size filters.

3.3 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234100

SECTION 235123 - GAS VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Listed double-wall vents.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for product.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents.
- B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. American Metal Products; MASCO Corporation.
 - 2. Cleaver-Brooks; Div. of Aqua-Chem Inc.
 - 3. Heat-Fab, Inc.

4. Industrial Chimney Company.
 5. Metal-Fab, Inc.
 6. Schebler Co. (The).
 7. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 8. Simpson Dura-Vent Co., Inc.; Subsidiary of Simpson Manufacturing Co.
 9. Van-Packer Company, Inc
- B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B or 550 deg F continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.
- D. Inner Shell: ASTM A666, Type 430 stainless steel or Aluminum alloy
- E. Outer Jacket: G90 galvanized steel or Aluminized steel.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
1. Termination: Standard rain cap

2.2 LISTED SPECIAL GAS VENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Heat-Fab, Inc.
 2. Metal-Fab, Inc.
 3. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 4. Z-Flex; Flexmaster Canada Limited.
- B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch airspace.
- D. Inner Shell: ASTM A 959, Type AL 29-4C stainless steel.
- E. Outer Jacket: Stainless steel.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
1. Termination: Standard rain cap.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Listed Type B and BW Vents: Vents for certified gas appliances.
- B. Listed Special Gas Vent: Condensing gas appliances or Non-Condensing gas appliances with fully modulating burner.

3.3 INSTALLATION OF LISTED VENTS

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
- B. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- D. Lap joints in direction of flow.

3.4 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION 235123

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

1.3 ACTION SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boilers to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- E. AHRI Compliance: Boilers shall be AHRI listed and must meet the minimum efficiency specified under AHRI BTS-2000 as defined by Department of Energy in 10 CFR Part 431.

- F. ANSI Compliance: Boilers shall be compliant with ANSI Z21.13 test standards for US and Canada

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period for Condensing Boilers:

- a. Leakage and Materials: Minimum 10 years from date of Substantial Completion.
 - b. Heat Exchanger, Pressure Vessel and Condensation Collection Basin shall carry a minimum 10 year limited warranty against defects in materials or workmanship and failure due to thermal shock and condensate corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fulton Boiler Works, Inc.
 - 2. Gasmaster Industries Incorporated.
 - 3. Hydrotherm, Inc.; a division of Mestek, Inc.
 - 4. Aerco
 - 5. Cleaver-Brooks.
 - 6. Heat Transfer Products, Inc.
 - 7. Lochinvar Corporation.
 - 8. Raypak.
 - 9. RBI.
 - 10. Laars Heating Systems; a division of Waterpik Technologies, Inc.
 - 11. Lochinvar Corporation.
 - 12. Patterson-Kelly
 - 13. Raypak

2.2 FIRE-TUBE CONDENSING BOILERS

- A. Description: Factory-fabricated, -assembled, and -tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water heating service only.
- B. Description: Boiler shall be natural gas fired, fully condensing, and fire tube design. The boiler shall be factory-fabricated, factory-assembled, and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls
- C. Heat Exchanger: The heater exchanger shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The heat exchanger shall be constructed of corrosion resistant stainless steel or cast aluminum and shall be capable of handling return water temperatures down to 50 F without any failure due to thermal shock or fireside condensation. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop.
- D. Condensate Collection Basin: Fully welded stainless steel with gravity drain for the elimination of condensate.
- E. Intake Filter and Dirty Filter Switch: Boiler shall include an intake air filter with a factory installed air pressure switch. The pressure switch will alert the end user on the screen of the boiler that the intake filter is dirty and needs to be changed.
- F. Pressure Vessel: Carbon steel with welded heads and tube connections.
- G. Burner: Natural gas, forced draft. Burner shall be high temperature stainless steel. The burner shall be capable of the stated gas train turndown without loss of combustion efficiency.
- H. Blower: Boiler shall be equipped with a blower system to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The burner firing sequence of operation shall include pre-purge, firing, modulation, and post-purge operation
 - 1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- I. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
- J. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.
- K. Burner Turndown/Modulation: Burner shall have minimum 10:1 turndown and be fully modulating. Provide higher turndown as scheduled.
- L. Casing:
 - 1. Jacket: Sheet metal, with snap-in or interlocking closures.
 - 2. Control Compartment Enclosures: NEMA 250, Type 1A.
 - 3. Finish: Baked-enamel or Powder-coated protective finish.
 - 4. Insulation: Minimum 1-inch-thick, mineral-fiber or polyurethane-foam insulation surrounding the heat exchanger.
 - 5. Combustion-Air Connections: Inlet and vent duct collars.
 - 6. Mounting base to secure boiler.

2.3 TRIM

- A. Aquastat Controllers: Operating, firing rate, and high limit.
- B. Safety Relief Valve: ASME rated.
- C. Pressure and Temperature Gage: Minimum 3-1/2-inch-diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.
- D. Boiler Air Vent: Manual.
- E. Drain Valve: Minimum NPS 3/4 hose-end gate valve.
- F. Condensate Neutralization Kit: Factory supplied condensate trap with condensate trip sensor, high capacity condensate receiver prefilled with appropriate medium.
- G. Circulation Pump: Non-overloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

2.4 CONTROLS

- A. The boiler shall have a built in Cascade controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of up to 8 boilers of different btu inputs without utilization of an external controller. The factory installed, internal cascade controller shall include:
 - 1. Lead lag:
 - 2. Efficiency optimization: The Control module shall allow multiple boilers to fire at minimum firing rate in lieu of Lead/Lag.
 - 3. Front end loading:
 - 4. Rotation of lead boiler: The Control module shall change the lead boiler every hour for the first 24 hours after initializing the Cascade. Following that, the leader will be changed once every 24 hours
- B. Boiler operating controls shall include the following devices and features:
 - 1. Control transformer.
 - 2. Set-Point Adjust: Set points shall be adjustable.
 - 3. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature.
- C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.
 - 1. High Temperature Cutoff: Automatic and manual reset stops burner if operating conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.
 - 2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.

3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
 4. High and Low Gas Pressure Switches: Pressure switches shall prevent burner operation on low or high gas pressure. Pressure switches to be manually reset on the control interface.
 5. Blocked Drain Switch: Blocked drain switch shall prevent burner operation when tripped. Switch to be manually reset on the control interface.
 6. Low air pressure switch: Pressure switches shall prevent burner operation on low air pressure. Switch to be manually reset on the control interface
 7. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for any lockout conditions.
- D. Building Automation System Interface: Factory installed BACnet MSTP gateway interface to enable building automation system to monitor, control, and display boiler status and alarms

2.5 ELECTRICAL POWER

- A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

2.6 SOURCE QUALITY CONTROL

- A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

- A. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.
- E. Install control wiring to field-mounted electrical devices.
- F. Install condensate neutralization kit in the condensate drain line.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 23 Section "Common Work Results for HVAC."
- E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.
- F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.
- G. Install piping from safety relief valves to nearest floor drain.
- H. Boiler Venting:
 - 1. Install flue venting kit and combustion-air intake.
 - 2. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks."
- I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.
 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Video training sessions. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 235216

SECTION 236200 - PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes packaged, refrigerant compressor and condenser units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For compressor and condenser units to include in operation and maintenance manuals. Include warranty and startup reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-In-Place Concrete" and Section 033053 "Miscellaneous Cast-In-Place Concrete."
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
- C. Coordinate location of piping and electrical rough-ins.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include the following:
 - a. Compressor failure.
 - 2. Warranty Period (Compressor Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 6 TO 120 TONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation; Commercial HVAC Systems.
 - 2. Johnson Controls, Inc.
 - 3. Trane
- A. Compressor: Hermetic scroll compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.
 - 1. Capacity Control: On-off compressor cycling.
- B. Refrigerant: R-32, R-454b or as scheduled.
- C. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils rated to 450 psig, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.
- D. Microchannel coil with integral subcooling on each circuit, rated at 650 psig.
 - 1. Construct coil casing of powder painted steel or stainless-steel frame with rubber isolation to separate the condenser coil to protect against corrosion.

2. Construct coil of two pass arrangement consisting of aluminum alloys for fins, tubes and manifolds containing a series of flat tubes with multiple, parallel flow microchannels layered between the refrigerant manifolds.
 3. Factory coated condenser coils with a flexible dip and baked epoxy coating.
- E. Condenser Fans: Propeller-type vertical discharge; either directly or belt driven. Include the following:
1. Permanently lubricated, ball-bearing totally enclosed motors.
 2. Separate motor for each fan.
 3. Dynamically and statically balanced fan assemblies.
- F. Operating and safety controls include the following:
1. Manual-reset, high-pressure cutout switches.
 2. Automatic-reset, low-pressure cutout switches.
 3. Low-oil-pressure cutout switch.
 4. Compressor-winding thermostat cutout switch.
 5. Three-leg, compressor-overload protection.
 6. Control transformer.
 7. Magnetic contactors for compressor and condenser fan motors.
 8. Timer to prevent excessive compressor cycling.
- G. Accessories:
1. Electronic programmable thermostat to control compressor and condenser unit and evaporator fan.
 2. Low-Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F with time-delay relay to bypass low-pressure switch.
- H. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:
1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.
 2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
 3. Gasketed control panel door.
 4. Condenser coil hail guard.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate compressor and condenser units according to ARI 306/110.
- B. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."
- C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. Testing Requirements: Factory test sound-power-level ratings according to ARI 370.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of compressor and condenser units.
- B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- B. Comply with mounting and anchoring requirements for seismic installations.
- C. Install compressor and condenser units on concrete base. Concrete materials and installation requirements are specified in Section 033000 "Cast-In-Place Concrete" and Section 033053 "Miscellaneous Cast-In-Place Concrete."
- D. Maintain manufacturer's recommended clearances for service and maintenance.
- E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

- A. Comply with requirements for piping in other Section 232113 "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- C. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.
- D. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
 - 2. Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Verify proper airflow over coils.
- C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- D. Compressor and condenser units will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - a. Inspect for physical damage to unit casing.
 - b. Verify that access doors move freely and are weathertight.
 - c. Clean units and inspect for construction debris.
 - d. Verify that all bolts and screws are tight.

- e. Adjust vibration isolation and flexible connections.
- f. Verify that controls are connected and operational.

- B. Lubricate bearings on fan motors.
- C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
- D. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.
- E. Measure and record airflow and air temperature rise over coils.
- F. Verify proper operation of condenser capacity control device.
- G. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- H. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units.

END OF SECTION 236200

SECTION 238113 - PACKAGED TERMINAL AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes packaged terminal air conditioners and their accessories and controls, in the following configurations:
 - 1. Through-the-wall or Through-the-window air conditioners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, electrical characteristics, and accessories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged terminal air conditioners to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.6 COORDINATION

- A. Coordinate layout and installation of packaged terminal air conditioners and existing conditions including other construction that penetrates walls or is supported by them.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Corporation; a United Technologies company.
 2. ClimateMaster, Inc.
 3. Friedrich Air Conditioning Co.
 4. General Electric Company; GE Consumer & Industrial - Appliances.
 5. Suburban Manufacturing Company; a subsidiary of AIRXCEL, Inc.
 6. Trane; a business of American Standard Companies.

2.2 MANUFACTURED UNITS

- A. Description: Factory-assembled and -tested, self-contained, packaged terminal air conditioner with room cabinet, electric refrigeration system, and temperature controls; fully charged with refrigerant and filled with oil; with cord-connected chassis.

2.3 CHASSIS

- A. Cabinet: Minimum 0.052-inch-thick steel with removable front panel with concealed latches.
1. Mounting: Wall with wall sleeve.
 2. Discharge Grille: Reversible polycarbonate discharge grille allowing upward and horizontal airflow.
 3. Finish: Epoxy coating.
 4. Access Door: Hinged door in top of cabinet for access to controls.
 5. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.
 6. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 7. Wall Sleeves: Galvanized steel with polyester finish.
- B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor; and hermetically sealed scroll compressor with vibration isolation and overload protection.
1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins.
 2. Charge: R-454b or R-32.
- C. Indoor Fan: Forward curved, centrifugal; with motor.
- D. Filters: Washable polyurethane in molded plastic frame.
- E. Condensate Drain: Drain pan to direct condensate to outdoor coil for re-evaporation.

1. Comply with ASHRAE 62.1 for drain pan construction and connections.
- F. Outdoor Fan: Forward curved, centrifugal or propeller type motor.
 1. Indoor and Outdoor Fan Motors: Two speed; comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - a. Fan Motors: Permanently lubricated split capacitor.
 - b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.4 CONTROLS

- A. Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation. Include the following features:
 1. Low Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg F outdoor air temperature.
- B. Remote Control: Standard unit-mounted controls with remote-mounted, low-voltage adjustable thermostat with heat anticipator, off-cool-auto switch, and on-auto fan switch.

2.5 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Factory test to comply with ARI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."
- B. Unit Performance Ratings: Factory test to comply with ARI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Reuse existing sleeve; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

3.2 CONNECTIONS

- A. Install piping adjacent to machine to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 2. After installing packaged terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Packaged terminal air conditioners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Perform startup service.
- B. After installation, verify the following:
 - 1. Unit is level on base and is flashed in exterior wall.
 - 2. Unit casing has no visible damage.
 - 3. Compressor, air-cooled condenser coil, and fans have no visible damage.
 - 4. Labels are clearly visible.
 - 5. Controls are connected and operable.
 - 6. Shipping bolts, blocks, and tie-down straps are removed.
 - 7. Filters are installed and clean.
 - 8. Drain pan and drain line are installed correctly.
 - 9. Electrical wiring installation complies with manufacturer's submittal and installation requirements in electrical Sections.
 - 10. Installation. Perform startup checks according to manufacturer's written instructions, including the following:
 - a. Lubricate bearings on fan.
 - b. Check fan-wheel rotation for correct direction without vibration and binding.
- C. After startup service and performance test, change filters.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain packaged terminal air conditioners.

END OF SECTION 238113

SECTION 238126 – DUCTLESS DX SPLIT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting and may be connected to ducts.
- B. Related Sections include:
 - 1. Division 23 Section "Common Motor Requirements for HVAC Equipment".
 - 2. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".
 - 3. Division 23 Section "Vibration Controls for HVAC".

1.3 PERFORMANCE REQUIREMENTS

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Fan curves shall include a series of curves indicating the relationship of CFM and static pressure for various RPM. Brake horsepower curves shall also be included. Indicate the design operating point clearly on the fan curves. Indicate fan brake horsepower requirement at the design operating point.
- C. Product data of filter media, filter performance data, filter assembly, and filter frames shall be provided
- D. Wiring Diagrams: For power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in operation and maintenance manuals. Include startup service reports and special warranty.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set for each indoor unit.
 - 2. Fan Belts: One set for each belt-driven unit fan

1.7 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with NFPA 90A and 90B.
- B. National Electric Code: Comply with NFPA 70.
- C. UL Compliance: UL listed to US and Canadian Safety Standards.
- D. AHRI Rating:
 - 1. Comply with AHRI 210/240 and ARI 340/360 for testing and rating energy efficiencies for split systems.
 - 2. Comply with AHRI 270 for testing and rating sound performance for split systems.

1.8 DESIGN CRITERIA

- A. The air conditioning equipment Condensing Unit shall be specifically designed for mounting in an outdoor application: curb or pedestal mounting as indicated on the drawings.
- B. Furnish units complete with fans, direct drive motors, coils, drain pans, compressors, condensing sections, integral cooling and heating controls, filter sections, adjustable frequency drives and access sections as shown on the plans and/or as scheduled.
- C. Units shall have the configuration and meet capacity and efficiency parameters as indicated on the plans and/or as scheduled.
- D. DX split systems shall be provided with all necessary tags and decals to aid in the service and/or indicate caution areas. Electrical wiring diagrams shall be attached to the control panel access door. Lifting lugs shall be supplied to facilitate rigging of the air-handling unit.
- E. Condensing unit and air handling unit shall be of same manufacturer.

1.9 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 07 Section "Roof Accessories."
- C. Coordinate size, location, and connection details with wall equipment supports and wall penetrations specified in Division Section "Wall Accessories."

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Daikin
 - 2. Johnson Controls
 - 3. LG
 - 4. Samsung
 - 5. Trane/Mitsubishi

2.2 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

- A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
 - 1. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 - 2. Drain Pan and Drain Connection: Comply with ASHRAE 62.1.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C. Fan: Direct drive, centrifugal fan.
- D. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Special Motor Features: Multi-tapped, multispeed with internal thermal protection and permanent lubrication.
- E. Filters: Permanent, cleanable or disposable, with ASHRAE 52.2 MERV rating of 6 or higher.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Zinc phosphatized steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting

holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing. Make all components suitable for outdoor mounting.

- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation and sound attenuating compartment within the chassis. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Compressor Type: Hermetic or semi-hermetic.
 - 2. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - 3. Refrigerant: R-454b, R-32 or as scheduled.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler and liquid accumulator. Pressure test at 245 psig minimum under water.
- D. Fan: Aluminum-propeller type, directly connected to motor, with safety guard for each fan.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Low Ambient Kit: Permits operation down to 45 deg F.
- G. Mounting Base: Polyethylene.
- H. Controls to be factory wired and located in a separate enclosure.
 - 1. Controls to include a control power transformer for 120 volt, 60 hertz, single phase, fusing, magnetic contactors for compressor and condenser motors, compressor overload protection, high and low pressure switches, differential oil pressure control, non-cycling pump down if required and reset relay, refrigerant discharge and suction pressure gauges, and oil pressure gauge.
 - 2. Furnish a positive acting timer to prevent short cycling of compressor if power is interrupted. Timer shall prevent compressor from restarting for approximately 5 minutes after shutoff.
- I. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."

2.4 WATER-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Zinc phosphatized steel, with baked-enamel finish in color selected by Architect, removable panels for access to controls, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing. Make all components suitable for outdoor mounting.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Compressor Type: Hermetic or semi-hermetic.
 - 2. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - 3. Refrigerant: R-407C, R-410A or as scheduled.

- C. Heat Exchanger: Copper tubes in copper tube or in steel shell, with water-temperature-actuated, water-regulating valve. Pressure test at 245 psig minimum under water.
- D. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."

2.5 ACCESSORIES

- A. Thermostat: Wired thermostat/controller functioning to remotely control compressor and evaporator fan, with the following features:
 - 1. Compressor time delay.
 - 2. 24-hour time control of system stop and start.
 - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 - 4. Fan-speed selection, including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
 - 1. Minimum Insulation Thickness: 1 inch thick.

2.6 REFRIGERANT CIRCUIT

- A. Each unit to have expansion valves, liquid receiver, filter driers and sightglass/moisture indicator. For Heat Pumps, provide heavy-duty, high capacity, pilot-operated reversing valves for automatic refrigerant cycle changeover.
- B. All fittings to be ACR type. All sweat-type fittings to be wrought copper or forged brass. All elbows and return bends to be of the long radius type. Flare fittings to be of the frostproof type and constructed of forged brass.
- C. Refrigeration Valves:
 - 1. Check valves 7/8" O.D. and smaller: Henry, Mueller, Superior, equal to Henry type #120 spring loaded piston check valves with accessible internal parts. Valve shall be provided with soft teflon seat, piston guide, stainless steel spring, 250 degrees F., 500 psig.
 - 2. Pressure Relief valves: Henry type #522, #52, #524, #523, #541, #542, #545, ASME approved pressure relief valves.
 - 3. Expansion valves: Alco, Sporlan, A.P., or equal. Unless specified otherwise, use externally equalized thermostatic expansion valves with superheat adjustment. Standard ratings to be in accordance with A.R.I. Standard 750-76.
 - 4. Liquid line solenoid valves: Alco, Sporlan, or approved equal. A.C.R. type valves to be U.L. listed.
 - 5. Hot gas bypass valves: Sporlan, Alco, Flo-Con or equal, electrically pilot operated. Unless specified otherwise, each valve shall be selected to maintain each system's minimum evaporating pressure. Multiple expansion valve, mixing tee, and any additional accessories required for proper system performance. All valves shall be UL listed.

D. Specialties:

1. Liquid driers 5/8" O.D. or smaller: Throwaway or replaceable core type. ARI Standard 710, UL listed.
2. Combination moisture and liquid indicators (sight glass): Sporlan, Superior, Alco, Henry, or equal, temperature compensating indicators, UL listed, 500 psig maximum working pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Compliance: In accordance with approved submittals and manufacturer's written installation instructions.
- B. Install units level and plumb.
- C. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- D. Install ground-mounting, compressor-condenser components on 6-inch-thick, reinforced concrete base; 6 inches larger on each side than unit..
- E. Install roof-mounting compressor-condenser components on equipment supports.
- F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- G. Mount units at proper height above floor or ceiling so that proper trap depth is provided in the condensate drain line.
- H. Install secondary auxiliary drain pans for all units located above ceilings or at other locations where building damage may occur from main drain pan overflow. Pipe auxiliary pan to nearest approved drain.
- I. Mount thermostats at 4'-0" above finished floor unless otherwise noted.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.
- E. Refrigerant Piping: Manufactured soldered ACR type fittings are preferred and shall be used wherever practical. The use of sliding block or lever type tube bending tools or flaring block or punch type swaging tools to field fabricate elbow or coupling type fittings will be allowed on piping 1-1/8" O.D. and smaller as long as the fittings are of the long radius type and are free from buckling or kinks. Field fabricated mitered elbows and tees will not be allowed.
- F. Valves in General:

1. Liquid line driers shall be of the filter drier type, and of the size recommended by the manufacturer. Drier cartridges shall not be installed until the second evacuation has been completed.
2. Install all valves per the manufacturer's instructions.
3. When brazing any valve to connecting piping, protect the valve properly against damage from excessive heating. For minimum protection, wrap a damp cloth around the valve body or remove internal valve parts before brazing and direct the flame away from the valve body.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - a. When the refrigeration connections have been completed, test the system at a minimum of 300 psig with the compressor suction and discharge valves closed, and all other valves in the system open. (If local codes require higher test pressures, such codes must be complied with). Sufficient liquid refrigerant shall be charged into the system to raise pressure to 35 psig, and dry nitrogen added to obtain the desired test pressure. Wrap all joints with a rubber or rawhide mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one once per year.
 - b. Refrigeration piping will not be acceptable unless it is gas tight. If any leaks are found, isolate the defective area, discharge the gas and repair the leaks, and then repeat the test. When testing has been completed, release all pressure freely to the atmosphere.
 - c. The system shall be evacuated with a vacuum duty pump specifically manufactured for refrigeration vacuum duty, having a capability of pulling a vacuum of at least 50 microns. Evacuation of the system must not be done by using refrigeration compressor. The pump should be connected to both the low and high side evacuation valves with copper tube or high vacuum hoses (1/4" I.D. minimum). The compressor service valves should remain closed. A high vacuum gauge capable of registering pressure in microns should be attached to the system for pressure reading. Hermetic or accessible- hermetic motor compressors must not be operated during evacuation because of the reduced dielectric strength of the atmosphere within the motor chamber. The check system pressure, a hand valve must be provided between the pressure gauge and the vacuum pump which can be closed to isolate the system and check the pressure.
 - d. Charge refrigerant directly from the original drums through a combination filter drier. Each drier may be used for a maximum of three cylinders of refrigerant, and then must be replaced with a fresh drier.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238126

SECTION 238219 – BLOWER COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Horizontal or vertical blower coil units and accessories.
- B. Related Sections include the following:
 - 1. Division 23 Section "General Duty Valves for Hydronic Piping for requirements for piping appurtenances including balancing valves and hook-up kits.

1.3 DEFINITIONS

- A. BAS: Building automation system.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, accessories, dimensions, weights, required clearances and location and size of each field connection.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fan-coil units to include in operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: Furnish one spare filter for each filter installed.
 - 2. Fan Belts: Furnish one spare fan belt for each belt-driven unit installed

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 COORDINATION

- A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

PART 2 - PRODUCTS

2.1 BLOWER COIL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Corporation; a UTC company.
 - 2. Johnson Controls / York.
 - 3. Daikin Applied
 - 4. ENVIRO-TEC; by Johnson Controls, Inc.
 - 5. International Environmental Corporation (IEC).
 - 6. Trane Inc.
- B. Drain Pans: Plastic, Stainless steel or Insulated galvanized steel with plastic liner. Fabricate pans and drain connections to comply with ASHRAE 62.1.
- C. Casing: Unfinished heavy-gauge galvanized steel
 - 1. Fan housing sides directly attached to top and bottom panels to strengthen unit.
 - 2. Coil access panels: Located on both sides of unit to allow for easy removal of internal coils and drain pan.
 - 3. Main access panels: Located on both sides of unit for easy access to fan, motor and drive.
 - 4. Duct collars: Provide at supply and return duct openings at unit. For unducted applications, provide ½"x ½" wiremesh aluminum screen to protect opening.
 - 5. Ducted applications: Provide return opening with mixing box or full sized plenum for connection of return and outdoor air ducts.
 - 6. Dampers: For mixing box, galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

- D. Coil Section Insulation: 1-inch-thick, foil-faced glass fiber or matte-finish, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916. All exposed seams shall be sealed to prevent fibers from reaching the airstream.
 - 1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1
- E. Drain Pans: Stainless steel pan, galvanized steel pan with plastic liner or plastic pan. Fabricate pans and drain connections to comply with ASHRAE 62.1.
- F. Filter rack: Standard filter rack. Filter rack configuration shall provide maximum 500 fpm at nominal airflow. Provide angled filter rack if required.
- G. Filters: Minimum efficiency reporting value (MERV):
 - 1. MERV Rating: MERV-8 and MERV-13 when tested according to ASHRAE 52.2.
- H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.
- I. Indoor Refrigerant Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and brazed joints at fittings. Comply with AHRI 210/240, and leak test to minimum 450 psig for a minimum 300-psig working pressure. Include thermal expansion valve
- J. Fans: Double width, forward curved, centrifugal. Galvanized, Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls. Direct Drive.
- K. Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor shall be electronic commutation type (EC Motor), capable of operating at single speed, three speeds or with 0-10 VDC input for single zone vav applications.
- L. Remote condensing units are specified in Section 236200 "Packaged Compressor and Condenser Units."
- M. Control devices and operational sequences are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Control Sequence." Provide DDC Terminal Controller by fan coil or BAS system manufacturer to provide complete control of fan and cooling/heating components.
- N. Basic Unit Controls:
 - 1. Control voltage transformer.
 - 2. 2 or 3 way, Modulating, Motorized control valve rated for minimum 300 psig service. Refer to plans for 2 or 3-way valve requirements. Valve shall have minimum close off pressure of 50 psig
 - 3. Unit control box: Control box shall contain all necessary devices to allow heating and cooling operation from a remote thermostat or sensor.
 - 4. Remote-mounted thermostat with the following features:

- a. Heat-cool-off switch.
 - b. Fan on-auto switch.
 - c. Fan-speed switch where multispeed motors are indicated.
 - d. Manual changeover.
 - e. Adjustable deadband.
 - f. Exposed set point.
 - g. Exposed indication.
 - h. Degree F indication.
- 5. Data entry and access port.
 - a. Input data includes room temperature, and humidity set points and occupied and unoccupied periods.
 - b. Output data includes room temperature and humidity, supply-air temperature, entering-water temperature, operating mode, and status
- O. BAS Interface Requirements:
 - 1. Interface relay for scheduled operation.
 - 2. Interface relay to provide indication of fault at the central workstation.
 - 3. Provide BACnet or LonWorks compatible interface for central BAS workstation for the following functions:
 - a. Adjust set points.
 - b. Blower-coil-unit start, stop, and operating status.
 - c. Data inquiry, including outdoor-air damper position, supply- and room-air temperature and humidity.
 - d. Occupied and unoccupied schedules
- P. Electrical Connection: Factory wire motors, components and controls for a single electrical connection. Provide factory mounted, integral non-fused incoming line side disconnect. Fuses shall be listed as branch circuit protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units level and plumb.

- B. Install units to comply with NFPA 90A.
- C. Suspend units from structure where indicated.. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
- D. Mount units at proper height above floor or ceiling so that proper trap depth is provided in the condensate drain line.
- E. Install secondary auxiliary drain pans for all horizontal units. Provide condensate overflow protection with auxillary float switch in auxiliary drain pan or at overflow drain when approved by AHJ. Upon detection of condensate overflow, de-energize fan and cooling.
- F. Provide condensate pump with pumped drain, unless gravity drain is provided. Field installed condensate pump shall be powered with means of disconnect from closest convenience receptacle circuit. Condensate pump overflow safety switch to be wired in series with primary condensate overflow protection to de-energize associated unit.
- G. For all fan coil units that are unducted, provide ½" x ½" galvanized wiremesh screen at the inlet and discharge openings.
- H. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor unless architect specifies otherwise.
- I. Install new filters in each unit prior to owner occupancy.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 - 1. Install piping adjacent to machine to allow service and maintenance.
 - 2. Connect piping to unit factory hydronic piping package. Install piping package if shipped loose.
 - 3. Connect condensate drain to nearest approved drain.
 - a. Install minimum 2" condensate trap for units without integral trap. Install cleanouts in piping at changes of direction.
- B. Connect supply and return ducts to ducted units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

- B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238219

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoplastic-insulated wire.
2. Nonmetallic jacketed cable.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" specifies materials and methods for sealing penetrations of rated walls and partitions referenced by this Section.
2. Section 260533.13 "Conduits for Electrical Systems" specifies installation of raceways referenced by this Section.
3. Section 260536 "Cable Trays for Electrical Systems" specifies cable tray installation referenced by this Section.

1.2 DEFINITIONS

- A. NICET: National Institute for Certification in Engineering Technologies; a division of the National Society of Professional Engineers (NSPE).

1.3 ACTION SUBMITTALS

- A. Product Schedule: Indicate type, use, location, and termination locations.
- B. Product Data: For each type of product.
- C. Field quality-control reports.

1.4 QUALIFICATIONS

- A. Electrical Power Testing (EPT) Technician III: Possessing active NICET EPT Level III certification. Able to manage switching procedures, to conduct tests of complex equipment, to analyze test and equipment data, to plan a job, and to lead a team. Has experience performing NFPA 70B, IEEE, and NETA electrical tests.
- B. Electrical Power Testing and Inspecting Agency: Entities possessing active credentials from qualified electrical testing laboratory recognized by authorities having jurisdiction.

1. On-site electrical testing supervisors must possess active NICET EPT Technician III certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 THERMOPLASTIC-INSULATED WIRE

- A. Description: Thermoplastic-insulated wire for use in accordance with Article 310 of NFPA 70.

- B. UL ZLGR - Type THHN Insulated Wire:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Alpha Wire; brand of Belden, Inc.
- b. Belden Inc.
- c. Cerro Wire LLC
- d. Encore Wire Corporation
- e. Okonite Company (The)
- f. Prysmian Cables and Systems; Prysmian Group North America
- g. Southwire Company, LLC

2. Standard Features:

- a. Referenced Standard: Article 310 of NFPA 70.
- b. Insulation Voltage Rating: 600 V.
- c. Insulation Temperature Rating: 90 deg C.
- d. Conductor Material: Copper.
- e. Conductor Size: As indicated on the Drawings.

- 1) Minimum Conductor Size: 12 AWG.

3. Other Available Features Required by the Project:

- a. Marked "Cable Tray Use" or "CT," indicating compliance with vertical-tray cable flame test.
- b. Marked "Sunlight Resistant" or "SR," indicating compliance with artificial weathering test.

C. UL ZLGR - Type THWN-2 Insulated Wire:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Alpha Wire; brand of Belden, Inc.
 - b. Belden Inc.
 - c. Cerro Wire LLC
 - d. Encore Wire Corporation
 - e. Okonite Company (The)
 - f. Prysmian Cables and Systems; Prysmian Group North America
 - g. Southwire Company, LLC
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Thermoplastic-Insulated Wire: UL CCN ZLGR, including UL 83.
3. Standard Features:
 - a. Referenced Standard: Article 310 of NFPA 70.
 - b. Insulation Voltage Rating: 600 V.
 - c. Insulation Temperature Rating: 90 deg C.
 - d. Conductor Material: Copper.
 - e. Conductor Size: As indicated on the Drawings.
 - 1) Minimum Conductor Size: 12 AWG.
4. Other Available Features Required by the Project:
 - a. Marked "Cable Tray Use" or "CT," indicating compliance with vertical-tray cable flame test.
 - b. Marked "Sunlight Resistant" or "SR," indicating compliance with artificial weathering test.

2.3 NONMETALLIC JACKETED CABLE

A. UL PWVX - Nonmetallic-Sheathed Cable, Type NM-B and Type NMC-B:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Belden Inc.
 - b. Cerro Wire LLC

- c. Copperweld
 - d. Encore Wire Corporation
 - e. Prysmian Cables and Systems; Prysmian Group North America
 - f. Republic Wire Inc.
 - g. Southwire Company, LLC
2. Standard Features:
- a. Referenced Standard: Article 334 of NFPA 70.
 - b. Insulation Voltage Rating: 600 V.
 - c. Insulation Temperature Rating: Individual conductors are rated 90 deg C for multiple conductor ampacity calculations; however, final cable ampacity rating must not exceed value for 60 deg C in Table 310.15(C)(1) of NFPA 70.
 - d. Conductor Material: Copper.
 - e. Conductor Size: As indicated on the Drawings.
 - 1) Minimum Conductor Size: 12 AWG.
 - f. Cable Covering:
 - 1) Type NM-B: Flame retardant and moisture resistant.
 - 2) Type NMC-B: Flame retardant, moisture resistant, fungus resistant, and corrosion resistant.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

- 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

- 1. Material: Copper.
 - a. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway Nonmetallic-sheathed cable, Type NM.

- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway Nonmetallic-sheathed cable, Type NM.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Electrical Maintenance: NFPA 70B.
 - 3. Electrical Safety: NFPA 70E.
 - 4. Temporary Electric Power Work: NECA NEIS 200.
 - 5. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
 - 6. Work in Confined Spaces: NFPA 350.
 - 7. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
 - 8. Installation of Type AC and Type MC Cables: NECA NEIS 120.
 - 9. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
 - 1. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
 - 2. Complete raceway installation between conductor and cable termination points prior to pulling conductors and cables.
 - 3. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - 4. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
 - 5. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
 - 6. Provide support for cables.
 - 7. Complete cable tray systems installation prior to installing conductors and cables.
 - 8. Connections:

- a. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
 - b. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
9. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch of slack.

D. Interfaces with Other Work:

1. Identification:
 - a. Identify and color-code conductors and cables.
 - b. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.
2. Sleeves and Sleeve Seals: Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.
3. Firestopping: Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.4 FIELD QUALITY CONTROL

A. Adminstrant for Electrical Power Tests and Inspections:

1. Engage qualified electrical testing and inspecting agency to administer and perform tests and inspections.

B. Field tests and inspections must be witnessed by Owner.

C. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
3. After installing conductors and cables and before electrical circuitry has been energized, test conductors feeding the following critical equipment and services for compliance with requirements:
 - a. Generator and main switchboard.
4. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection in accordance with the single-line diagram.
 - b. Test bolted connections for high resistance using one or more of the following:

- 1) Calibrated torque wrench.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Uniform resistance of parallel conductors.
- D. Nonconforming Work:
1. Wire or cable assembly will be considered defective if it does not pass tests and inspections.
 2. Remove and replace defective units and retest.
- E. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.5 MAINTENANCE

- A. Infrared Scanning of Splices: Two months after Substantial Completion, perform infrared scan of splices, joints, and connections in conductors 3 AWG and larger. Remove covers so splices, joints, and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison. Correct deficiencies determined during the scan.
1. Field Reports for Infrared Scanning: Prepare certified report that identifies cables splices checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 260519

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT duct raceways and elbows.
2. Type ERMCT duct raceways, elbows, couplings, and nipples.
3. Fittings for conduit, tubing, and cable.

B. Related Requirements:

1. Section 018116 "Facility Environmental Requirements" specifies temperature, humidity, acoustical, and other field conditions applicable to the Work specified in this Section.
2. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" specifies nonmetallic underground conduit with conductors (Type NUCC).
3. Section 260543 "Underground Ducts and Raceways for Electrical Systems" specifies exterior duct banks, manholes, and underground utility construction.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. ERMCT: Electrical rigid metal conduit.
5. ERMCT-S: Steel electrical rigid metal conduit.
6. RMC: See ERMCT.

B. Definitions:

1. Conduit: A structure containing one or more duct raceways.
2. Duct Raceway: A single enclosed raceway for conductors or cable.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Field quality-control reports.

1.4 QUALIFICATIONS

- A. Electrical Power Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - 1. On-site electrical testing supervisors must possess active NICET EPT Technician III certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 TYPE EMT DUCT RACEWAYS AND ELBOWS

- A. UL FJMX - Aluminum Electrical Metal Tubing (EMT-A) and Elbows:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Conduit; Norsk Hydro ASA, Hydro Extrusion USA LLC
 - b. Patriot Aluminum Products, LLC
 - c. Penn Aluminum Conduit & EMT; Penn Aluminum International LLC; Berkshire Hathaway
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FJMX; including UL 797A.
 - 3. Standard Features:
 - a. Material: Aluminum.
 - b. Minimum Trade Size: Metric designator 21 (trade size 3/4).
- B. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit; Atkore International

- b. Calconduit; Atkore International
 - c. Emerson Electric Co., Automation Solutions
 - d. Picoma; Zekelman Industries
 - e. Republic Conduit; Nucor Corporation, Nucor Tubular Products
 - f. Topaz Lighting & Electric
 - g. Western Tube; Zekelman Industries
 - h. Wheatland Tube; Zekelman Industries
- 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FJMX; including UL 797.
- 3. Standard Features:
 - a. Material: Steel.
 - b. Exterior Coating: Zinc.
 - c. Interior Coating: Zinc.
 - d. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.3 TYPE ERM C DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERM C-S-G), Elbows, Couplings, and Nipples:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit; Atkore International
 - b. Calconduit; Atkore International
 - c. Crouse-Hinds; brand of Eaton, Electrical Sector
 - d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - e. Patriot Aluminum Products, LLC
 - f. Republic Conduit; Nucor Corporation, Nucor Tubular Products
 - g. Rymco USA brand; manufactured and listed by subsidiary Conduit S.A. de C.V
 - h. Topaz Lighting & Electric
 - i. Western Tube; Zekelman Industries
 - j. Wheatland Tube; Zekelman Industries
- 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN DYIX; including UL 6.
- 3. Standard Features:

- a. Exterior Coating: Zinc.
- b. Interior Coating: Zinc.
- c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.4 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. UL FKA V - Fittings for Type EMT Duct Raceways:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Allied Tube & Conduit; Atkore International
 - c. Appleton; Emerson Electric Co., Automation Solutions
 - d. Calconduit; Atkore International
 - e. Crouse-Hinds; brand of Eaton, Electrical Sector
 - f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - h. Southwire Company, LLC
 - i. Topaz Lighting & Electric
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN FKA V; including UL 514B.
3. Standard Features:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturer's published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
 1. Exposed and Subject to Severe Physical Damage: ERM C.

2. Exposed and Subject to Physical Damage: ERM C.
3. Exposed and Not Subject to Physical Damage: ERM C Corrosion-resistant EMT.
4. Concealed Aboveground: ERM C EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:

1. Exposed and Subject to Severe Physical Damage: ERM C.
2. Exposed and Subject to Physical Damage: ERM C.
3. Exposed and Not Subject to Physical Damage: ERM C EMT.
4. Concealed in Ceilings and Interior Walls and Partitions: ERM C EMT.
5. Damp or Wet Locations: ERM C Corrosion-resistant EMT.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

1. ERM C and IMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IF C, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Electrical Safety: NFPA 70E.
3. Commissioning of Active and Passive Fire Protection Features: NFPA 3 and NFPA 4.
4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
5. Life Safety and Means of Egress Work: NFPA 101.
6. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
7. Type EMT-A: Article 358 of NFPA 70 and NECA NEIS 102.
8. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
9. Type ERM C-A: Article 344 of NFPA 70 and NECA NEIS 102.
10. Type ERM C-S: Article 344 of NFPA 70 and NECA NEIS 101.
11. Expansion Fittings: NEMA FB 2.40.
12. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:
 - a. Complete duct raceway installation before starting conductor installation.
 - b. Install no more than equivalent of three 90-degree bends in conduit run. Support within **12 inch** of changes in direction.

- c. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
 - d. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 - e. Support conduit within **12 inch** of enclosures to which attached.
 - f. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:
 - 1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2) Conduit extending from interior to exterior of building.
 - 3) Where otherwise required by NFPA 70.
 - g. Do not install conduits within **2 inch** of the bottom side of a metal deck roof.
 - h. Keep duct raceways at least **6 inch** away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
 - i. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - j. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than **200 lb** tensile strength. Leave at least **12 inch** of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
 - k. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - 1) Termination fittings with shoulders do not require two locknuts.
 - l. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
2. Types ERM and IMC:
- a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
3. Stub-ups to Above Recessed Ceilings:
- a. Provide EMT, IMC, or ERM for duct raceways.

- b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
 - 4. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.
 - 5. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
 - a. ERM-C-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - b. EMT: Provide setscrew compression, steel fittings. Comply with NEMA FB 2.10.
 - c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
 - 6. Expansion-Joint Fittings:
 - a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed **30 deg F** and that have straight-run length that exceeds **25 ft**. Install in runs of aboveground ERM-C and EMT conduit that are located where environmental temperature change may exceed **100 deg F** and that have straight-run length that exceeds **100 ft**.
 - b. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 - c. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
 - D. Interfaces with Other Work:
 - 1. Firestop penetrations of fire-rated floor and wall assemblies.
 - 2. Provide conduit hangers and supports.
- 3.3 FIELD QUALITY CONTROL OF CONDUITS FOR ELECTRICAL SYSTEMS
- A. Administrant for Electrical Power Tests and Inspections:
 - 1. Administer and perform tests and inspections.
 - B. Field tests and inspections must be witnessed by authorities having jurisdiction.
 - C. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum **12 inch** long mandrel equal to duct size minus **1/4 inch**. If obstructions are indicated, remove obstructions and retest.
3. Conduit Placement:
 - a. Verify that center-line location and offsets are in accordance with the Drawings.
 - b. Verify that hangers and supports for conduits are attached to structure as directed by qualified structural engineer.
 - c. Verify that nuts on bolts or hanger rods are secure.
 - d. Verify that space between raceways and cored holes are filled with non-shrinking grout or other approved material indicated on the Drawings and the Specifications.
 - e. Verify that expansion devices are installed at locations indicated on the Drawings and the Specifications.
 - f. Verify that ends are cut square to provide flush-butting surfaces when spliced and inside edges are free of burrs that could impede installation of cables.
 - g. Verify minimum separation of utilities, or that approved mechanical protection has been provided to surrounding conduit(s) where minimum separation cannot be achieved.
4. Document all changes on Record Drawings.

D. Nonconforming Work:

1. Conduit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.4 CLEANING

- A. Verify that bentonite or other drilling fluids are contained and removed, and site is restored to its original or improved condition.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533.13

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.

B. Related Requirements:

1. Section 018116 "Facility Environmental Requirements" specifies temperature, humidity, acoustical, and other field conditions applicable to the Work specified in this Section.

1.2 DEFINITIONS

A. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.

B. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

1. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
2. Concrete Box: A box intended for use in poured concrete.
3. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
4. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
5. Cover Plate: A cover designed for protecting wiring devices installed in flush-mounted device boxes while permitting their safe operation; also called a faceplate or wallplate.
6. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
7. Device Box: A box with provisions for mounting a wiring device directly to the box.
8. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
9. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
10. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.

11. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
 12. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 13. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 14. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
 15. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 16. Raised-Floor Box: A floor box intended for use in raised floors.
 17. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
 18. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
 19. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 20. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 21. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
- C. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
- D. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. UL QCIT - Metallic Outlet Boxes and Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Arlington Industries, Inc.
 - d. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - f. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - g. MonoSystems, Inc
 - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - i. Pass & Seymour; Legrand North America, LLC
 - j. Patriot Aluminum Products, LLC
 - k. Plasti-Bond; Robroy Industries
 - l. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - m. Spring City Electrical Manufacturing Company
 - n. Topaz Lighting & Electric
 - o. Wiremold; Legrand North America, LLC
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
3. Standard Features:
 - a. Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
 - b. Material: Sheet steel Cast metal.
 - c. Sheet Metal Depth: Minimum **1.5 inch**.
 - d. Cast-Metal Depth: Minimum **1.8 inch**.
4. Other Available Features Required by the Project:
 - a. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to **50 lb**.

B. UL QCIT - Metallic Device Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Appleton; Emerson Electric Co., Automation Solutions
 - c. Arlington Industries, Inc.
 - d. Crouse-Hinds; brand of Eaton, Electrical Sector
 - e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group
 - i. Patriot Aluminum Products, LLC
 - j. Plasti-Bond; Robroy Industries
 - k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - l. Topaz Lighting & Electric
2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCIT; including UL 514A.
3. Standard Features:
 - a. Box with provisions for mounting wiring device directly to box.
 - b. Material: Sheet steel Cast metal.
 - c. Sheet Metal Depth: minimum **1.5 inch**.
 - d. Cast-Metal Depth: minimum **1.8 inch**.

2.3 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. UL QCMZ - Nonmetallic Outlet Boxes and Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Allied Tube & Conduit; Atkore International
 - c. Appleton; Emerson Electric Co., Automation Solutions
 - d. Arlington Industries, Inc.
 - e. Arrow Hart, Wiring Devices; Eaton, Electrical Sector
 - f. Cantex Inc.
 - g. Crouse-Hinds; brand of Eaton, Electrical Sector

- h. Ericson Manufacturing Company
 - i. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - j. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - k. Intermatic, Inc
 - l. JM Eagle
 - m. Leviton Manufacturing Co., Inc.
 - n. Panduit Corp
 - o. Pass & Seymour; Legrand North America, LLC
 - p. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - q. Topaz Lighting & Electric
 - r. Wiremold; Legrand North America, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
 - 3. Standard Features: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
- B. UL QCMZ - Nonmetallic Device Boxes:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Allied Tube & Conduit; Atkore International
 - c. Arlington Industries, Inc.
 - d. Cantex Inc.
 - e. Crouse-Hinds; brand of Eaton, Electrical Sector
 - f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - g. Pass & Seymour; Legrand North America, LLC
 - h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. UL CCN QCMZ; including UL 514C.
 - 3. Standard Features: Box with provisions for mounting wiring device directly to box.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 - 1. Outdoors:
 - a. Type 3R unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4.
 - c. Locations Subject to Potential Flooding: Type 6P.
 - d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
 - 2. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Damp or Dusty Locations: Type 12.
 - c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - e. Locations Exposed to Hosedown: Type 4.
 - f. Locations Exposed to Brief Submersion: Type 6.
 - g. Locations Exposed to Prolonged Submersion: Type 6P.
- C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
 - 1. Boxes with knockouts or unprotected openings are prohibited.
 - 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 - 2. Electrical Safety: NFPA 70E.
 - 3. Commissioning of Active and Passive Fire Protection Features: NFPA 3 and NFPA 4.

4. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
5. Communications Work: BICSI N1.
6. Life Safety and Means of Egress Work: NFPA 101.
7. Emergency and Standby Power Work: NFPA 110, NFPA 111, and NECA NEIS 416.
8. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
9. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Set metal floor boxes level and flush with finished floor surface.
10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
11. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

3.3 FIELD QUALITY CONTROL OF BOXES AND COVERS

A. Administrant for Electrical Power Tests and Inspections:

1. Engage qualified medium-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
2. Administer and perform tests and inspections.

B. Administrant for Communications Tests and Inspections:

1. Administer and perform tests and inspections with assistance of factory-authorized service representative.

C. Administrant for Security Tests and Inspections:

1. Administer and perform tests and inspections.
- D. Field tests and inspections must be witnessed by authorities having jurisdiction.
- E. Tests and Inspections:
 1. Perform manufacturer's recommended tests and inspections.
- F. Nonconforming Work:
 1. Boxes and covers will be considered defective if they do not pass tests and inspections.
 2. Remove and replace defective units and retest.
- G. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.4 CLEANING

- A. Remove construction dust and debris from boxes before installing cover plates, covers, and hoods.

3.5 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal cable trays.
 - 2. Cable tray accessories.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Metal cable trays.
 - 2. Cable tray accessories.
- B. Shop Drawings:
 - 1. Cable tray fabrication drawings, diagrams, and supporting documents.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CABLE TRAYS

- A. Description: This product category covers metal cable trays and metal cable tray systems intended for field assembly and for use in accordance with Article 392 of NFPA 70.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN CYNW; including NEMA VE 1 and suitability for use as equipment grounding conductors in accordance with Sections 392.60(A) and 392.60(B) of NFPA 70.
- C. UL CYNW - Wire-Mesh Cable Tray:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Atkore Cope
 - b. BASOR Electric
 - c. Cablofil; Legrand North America, LLC
 - d. Chalfant Manufacturing Company
 - e. Cooper B-line; brand of Eaton, Electrical Sector
 - f. Enduro Composites Inc.
 - g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - h. MonoSystems, Inc
 - i. MP Husky USA Cable Tray & Cable Bus
 - j. Niedax Inc.
 - k. Snaketray
 - l. WBT LLC
2. Source Limitations: Obtain products from single manufacturer.
3. General Characteristics:
 - a. Configuration: steel wire mesh, complying with NEMA VE 1.
 - b. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a **50 lb.** concentrated load, when tested in accordance with NEMA VE 1.
 - c. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - d. Splice-Plate Capacity: Splices located within support span must not diminish rated loading capacity of cable tray.
4. Materials and Finishes (Steel):
 - a. Straight Sections and Fittings: Steel complies with the minimum mechanical properties of ASTM A1008/A1008M, Grade 33, Type 2.
 - b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
 - c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
 - d. Finish:
 - 1) Powder-coat enamel paint, with stainless steel, Type 316, ASTM F593 and ASTM F594 hardware.
 - a) Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
5. Options:
 - a. Width: **6 inch** unless otherwise indicated on Drawings.
 - b. Minimum Usable Load Depth: **2 inch.**

- c. Straight Section Lengths: **10 ft**, except where shorter lengths are required to facilitate tray assembly.
- d. Class Designation: Comply with NEMA VE 1, Class 8A.

2.2 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Barrier Strips: Same materials and finishes as for cable tray.
- C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.3 SOURCE QUALITY CONTROL

- A. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Shop Drawings: Prepare and submit the following for each cable tray system:
 - 1. Cable Tray Fabrication Drawings, Diagrams, and Supporting Documents:
 - a. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

3.2 INSTALLATION OF CABLE TRAYS

- A. Install cable tray and support systems in accordance with NEMA VE 2.
- B. Install cable tray as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable tray, so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

- D. Remove burrs and sharp edges from cable trays.
- E. Fasten cable tray supports to building structure.
- F. Place supports, so that spans do not exceed maximum spans on schedules, and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of tray rungs.
- G. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- H. Support assembly to prevent twisting from eccentric loading.
- I. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- J. Do not install more than one cable tray splice between supports.
- K. Support wire-basket cable trays with wall brackets.
- L. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed recommended dimensions. Space connectors and set gaps in accordance with applicable standard.
- M. Make changes in direction and elevation using manufacturer's recommended fittings.
- N. Make cable tray connections using manufacturer's recommended fittings.
- O. Seal penetrations through fire and smoke barriers.
- P. Install cable trays with enough workspace to permit access for installing cables.

3.3 INSTALLATION OF CABLES

- A. Install cables only when each cable tray run has been completed and inspected.
- B. In existing construction, remove inactive or dead cables from cable trays.

3.4 FABRICATION OF CONNECTION POINTS

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays in accordance with requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items, such as pipes, hangers, or other equipment, in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
- C. Nonconforming Work:
 - 1. Cable tray will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.
- E. Manufacturer Services: Engage factory-authorized service representative to support field tests and inspections.
 - 1. Manufacturer's Field Reports for Field Quality-Control Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at Project site.

3.6 PROTECTION

- A. Protect installed cable trays and cables.
 - 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and must remain in place until the risk of damage is over.
 - 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray

- manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 260536

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type PVC raceways and fittings.

B. Related Requirements:

1. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" specifies nonmetallic underground conduit with conductors (Type NUCC).

1.2 DEFINITIONS

- A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.
- B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.
- C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.
- D. Manhole: An underground chamber containing electrical cables and equipment, sized to provide access with working space clearances.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For concrete and steel used in precast concrete handholes, also include product certificates as required by ASTM C858.

B. Shop Drawings:

1. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes, and methods and

- materials for waterproofing duct entry locations.
- c. Include cover design.
- d. Include grounding details.
- e. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and other accessories.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL CCN DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Calconduit; Atkore International
 - c. JM Eagle
 - d. NAPCO; Westlake Chemical Corp.
 - e. National Pipe and Plastic, Inc. (Oldcastle)
 - f. Opti-Com Manufacturing Network, Inc (OMNI)
 - g. Topaz Lighting & Electric
2. Dimensional Specifications: Schedule 40.
3. Options:
 - a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
 - b. Markings: For use with maximum 90 deg C wire.

2.2 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

2.3 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL CCN DWTT.

2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
 - a. ASTM C858 for design and manufacturing processes.
 - b. SCTE 77.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

3.2 SELECTION OF UNDERGROUND DUCTS

- A. Duct for Electrical Feeders 600 V and Less: PVC-40, concrete encased unless otherwise indicated.
- B. Duct for Electrical Branch Circuits: PVC-40, direct buried unless otherwise indicated.
- C. Underground Ducts Crossing Paved Paths Walks and Driveways: PVC-40 encased in reinforced concrete.

- D. Underground Ducts Crossing Roadways and Railroads: PVC-40, encased in reinforced concrete.
- E. Stub-ups: Concrete encased, ERM-C-S.

3.3 SELECTION OF UNDERGROUND ENCLOSURES

- A. Handholes and Boxes:
 - 1. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer concrete frame and cover, SCTE 77, Tier 8 or High-density plastic, SCTE 77, Tier 8 structural load rating.
 - 2. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin or High-density plastic, structurally tested in accordance with SCTE 77 with **3000 lbf** vertical loading.
 - 3. Cover design load must not exceed load rating of handhole or box.

3.4 EARTHWORK

- A. Restoration: Restore area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- B. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.
- D. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures.

3.5 INSTALLATION OF DUCTS AND DUCT BANKS

- A. Reference Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
 - 2. Consult Architect for resolution of conflicting requirements.
- B. Special Techniques:
 - 1. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with minimum **3 inch** of concrete for

- minimum of **12 inch** on each side of coupling.
2. Install manufactured steel raceway elbows for stub-ups at poles unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - a. Couple steel elbows to ducts with adapters designed for this purpose, and encase coupling with minimum **3 inch** of concrete for minimum of **12 inch** on each side of coupling.
 3. Pulling Cord: Install **200 lbf** test nylon cord in empty ducts.
 4. Concrete-Encased Ducts and Duct Bank:
 - a. Excavate trench bottom to provide firm and uniform support for duct.
 - b. Width: Excavate trench **3 inch** wider than duct on each side.
 - c. Depth: Install so top of duct envelope is at least **24 inch** below finished grade.
 - d. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
 - e. Minimum Space between Ducts: **3 inch** between edge of duct and exterior envelope wall, **2 inch** between ducts for like services, and **4 inch** between power and communications ducts.
 - f. Elbows:
 - 1) Use manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct run.
 - g. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 - h. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 - i. Concrete Cover: Install minimum of **3 inch** of concrete cover between edge of duct to exterior envelope wall, **2 inch** between duct of like services, and **4 inch** between power and communications ducts.
 - j. Place minimum **6 inch** of engineered fill above concrete encasement of duct.
 - k. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - 1) Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed in accordance with manufacturer's published instructions, or use other specific measures to prevent expansion-contraction damage.
 - 2) If more than one pour is necessary, terminate each pour in vertical plane and install **3/4 inch** reinforcing-rod dowels extending minimum of **18 inch** into concrete on both sides of joint near corners of envelope.
 5. Direct-Buried Duct and Duct Bank:
 - a. Excavate trench bottom to provide firm and uniform support for duct.

- b. Width: Excavate trench **3 inch** wider than duct on each side.
 - c. Depth: Install top of duct at least **24 inch** below finished grade unless otherwise indicated.
 - d. Set elevation of top of duct bank below frost line.
 - e. Place minimum **3 inch** of sand as bed for duct. Place sand to minimum of **6 inch** above top level of duct.
 - f. Install duct with minimum of **3 inch** between ducts for like services and **6 inch** between power and communications duct.
 - g. Install manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct.
 - 1) Couple RNC duct to steel raceway with adapters designed for this purpose, and encase coupling with minimum **3 inch** of concrete.
 - h. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to **4 inch** over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
6. Underground-Line Warning Tape: Bury nonconducting underground warning tape **12 inch** above concrete-encased duct and duct banks and approximately **12 inch** below grade. Align tape parallel to and within **3 inch** of centerline of duct bank.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Reference Standards:

- 1. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:

- 1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- 2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from **1/2 inch** sieve to **No. 4** sieve and compacted to same density as adjacent undisturbed earth.
- 3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes **1 inch** above finished grade.
- 4. Install handholes with bottom below frost line.
- 5. Field cut openings for duct in accordance with enclosure manufacturer's published

instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

6. Ground handholes as indicated on drawings.

3.7 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum **12 inch** long mandrel equal to duct size minus **1/4 inch**. If obstructions are indicated, remove obstructions and retest.
 3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections.
- C. Nonconforming Work:
 1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
 2. Correct deficiencies and retest as specified above to demonstrate compliance.
- D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.8 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.
 1. Sweep floor, removing dirt and debris.
 2. Remove foreign material.

END OF SECTION 260543

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Switchboards.
 - 2. Accessory components and features.

1.2 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Switchboards.
 - 2. Overcurrent protective devices.
 - 3. Accessories.
 - 4. Other components.
 - 5. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types for types other than UL 50E, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
 - 5. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Field Quality-Control Submittals:

1. Field Quality-Control Reports:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to switchboards, that are packaged with protective covering for storage on-site and identified with labels describing contents.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Handle and prepare switchboards for installation in accordance with NECA 400.

1.7 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that switchboard performs in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended-warranty period.
 1. Initial Extended-Warranty Period: 4 years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. ABB Electrification Installations Products
 2. Eaton
 3. Siemens Industry, Inc., Energy Management Division

4. Square D; Schneider Electric USA
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- D. Comply with NEMA PB 2.
- E. Comply with NFPA 70.
- F. Comply with UL 891.
- G. Front-Connected, Front-Accessible Switchboards:
 1. Main Devices: Panel mounted.
 2. Branch Devices: Panel mounted.
 3. Sections front and rear aligned.
- H. Nominal System Voltage: 208Y/120 V.
- I. Main-Bus Continuous: 2000 A.
- J. Indoor Enclosures: Steel, UL 50E, Type 1 or Type 2.
- K. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over rust-inhibiting primer on treated metal surface.
- L. Barriers: Between adjacent switchboard sections.
- M. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.
- N. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- O. Buses and Connections: Three phase, four wire unless otherwise indicated.
 1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from front of switchboard.
 2. Phase- and Neutral-Bus Material:
 - a. Hard-drawn copper of 98 percent conductivity.
 3. Copper feeder circuit-breaker line connections.
 4. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.

5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
6. Disconnect Links:
 - a. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
7. Neutral Buses: 100 percent of ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long and short time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards in accordance with NECA 400.
 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's published instructions.

2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
 3. Protect from moisture, dust, dirt, and debris during storage and installation.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
 - C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect performance of equipment.
 - D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 1. Switchboards and Accessories: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 400.
 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
 1. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
 2. Install filler plates in unused spaces of panel-mounted sections.
 3. Install overcurrent protective devices, surge protection devices, and instrumentation.

3.4 CONNECTIONS

- A. Bond conduits entering underneath switchboard to equipment ground bus with bonding conductor sized in accordance with NFPA 70.
- B. Support and secure conductors within switchboard in accordance with NFPA 70.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.5 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification.
- B. Provide labels for switchboard and each individual compartment identifying branch load.
- C. Service Equipment Label: Labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

3.6 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 - 2. Test ground-fault protection of equipment for service equipment in accordance with NFPA 70.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Nonconforming Work:
 - 1. Switchboard will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Collect, assemble, and submit test and inspection reports, including certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- E. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature in accordance with manufacturer's published instructions, until switchboard is ready to be energized and placed into service.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panelboards.
2. Disconnecting and overcurrent protective devices.

B. Related Requirements:

1. Section 018116 "Facility Environmental Requirements" specifies temperature, humidity, acoustical, and other field conditions applicable to the Work specified in this Section.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. In addition to information identified in Section 013300 "Submittal Procedures," submit the following:

1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
2. Include manufacturer's sample extended warranty language.

B. Shop Drawings: For each panelboard and related equipment:

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.

- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare parts.
- B. Special tools.

1.6 QUALIFICATIONS

- A. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation in accordance with NECA 407.

1.8 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
 - 1. Initial Extended-Warranty Period: Four years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Fabricate and test panelboards in accordance with IEEE 344 to withstand seismic forces specified in Section 018123 "Facility Seismic and Wind Criteria."

- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Comply with NEMA PB 1.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: UL 50E, Type 1.
 - b. Outdoor Locations: UL 50E, Type 3R.
 - c. Kitchen and Wash-Down Areas: UL 50E, Type 4X.
 - d. Other Wet or Damp Indoor Locations: UL 50E, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
 - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
- F. Phase, Neutral, and Ground Buses:
 - 1. Material: Tin-plated aluminum.
 - a. Plating must run entire length of bus.
 - b. Bus must be fully rated for entire length.
 - 2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum.
 - 2. Terminations must allow use of 75 deg C rated conductors without derating.

3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: Mechanical type, with lug on neutral bar for each pole in panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with lug on bar for each pole in panelboard.
- H. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- I. Panelboard Short-Circuit Current Rating:
1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.
 - a. Panelboards short circuit rating to match existing panelboards being replaced.

2.2 PANELBOARDS

- A. UL QEUY - Distribution Panelboard:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Eaton
 - c. ESL Power Systems, Inc.
 - d. Mersen USA
 - e. Siemens Industry, Inc., Energy Management Division
 - f. Square D; Schneider Electric USA
 2. Source Limitations: Obtain products from single manufacturer.
 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Distribution Type Panelboards: UL CCN QEUY; including UL 67 and NEMA PB 1.
 4. Standard Features:
 - a. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1) For doors more than 36 inch high, provide two latches, keyed alike.

- b. Mains: As shown on panel schedules.
 - 1) Location: To match existing panelboard.
 - c. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
 - d. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.
5. Other Available Features Required by Project:
- a. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
 - b. Do not mount neutral bus in gutter.
 - c. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
- B. UL QEUY - Lighting and Appliance Branch-Circuit Panelboard:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABB Electrification Installations Products
 - b. Bender Inc.; Bender GmbH & Co. KG
 - c. Eaton
 - d. Siemens Industry, Inc., Energy Management Division
 - e. Square D; Schneider Electric USA
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Lighting and Appliance Branch-Circuit Type Panelboards: UL CCN QEUY; including UL 67 and NEMA PB 1.
 - 4. Standard Features:
 - a. Mains: As shown on panel schedules.
 - 1) Location: To match existing panelboards.
 - 2) Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.
 - b. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

5. Other Available Features Required by Project:
 - a. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
 - b. Do not mount neutral bus in gutter.
 - c. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
 - d. Doors: Door-in-door construction with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. ABB Electrification Installations Products
 2. Eaton
 3. Siemens Industry, Inc., Energy Management Division
 4. Square D; Schneider Electric USA
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
 4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
 5. Subfeed Circuit Breakers: Vertically mounted.
 6. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

- g. Rating Plugs: Three-pole breakers with ampere ratings greater than 250 A must have interchangeable rating plugs or electronic adjustable trip units.
- h. Multipole units enclosed in single housing with single handle or factory assembled to operate as single unit.

2.4 MAINTENANCE MATERIAL ITEMS

- A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards and related equipment, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers shall have 5 spares for each breaker type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards in accordance with NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 407.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Equipment Mounting:

- a. Attach panelboard to vertical finished or structural surface behind panelboard.
 - b. Mount surface-mounted panelboards to steel slotted supports **5/8 inch** in depth. Orient steel slotted supports vertically.
 2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
 3. Provide mounting and anchoring devices.
 4. Mount panelboard cabinet plumb and rigid without distortion of box.
 5. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
 6. Install overcurrent protective devices and controllers not already factory installed.
 - a. Set field-adjustable, circuit-breaker trip ranges.
 - b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
 7. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
 8. Install filler plates in unused spaces.
 - D. Interfaces with Other Work:
 1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- ### 3.3 IDENTIFICATION
- A. Install warning signs.
 - B. Panelboard Nameplates: Label each panelboard with nameplate.
 - C. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.
 - D. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.
 - E. Circuit Directory:
 1. Provide directory card inside panelboard door, mounted in metal frame with transparent protective cover.
 - a. Circuit directory must identify specific purpose with detail sufficient to distinguish

it from other circuits.

2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
3. Create directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

3.4 FIELD QUALITY CONTROL

- A. Administrant for Low-Voltage Electrical Tests and Inspections:
 1. Administer and perform tests and inspections with assistance of factory-authorized service representative.
- B. Acceptance Testing Preparation:
 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Field tests and inspections must be witnessed by authorities having jurisdiction.
- D. Tests and Inspections:
 1. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Nonconforming Work:
 1. Panelboards will be considered defective if they do not pass tests and inspections.
 2. Remove and replace defective units and retest.
- F. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

1. Include certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade duplex straight-blade receptacles.
3. Receptacles with arc-fault and ground-fault protective devices.

B. Related Requirements:

1. Section 018116 "Facility Environmental Requirements" specifies temperature, humidity, acoustical, and other field conditions applicable to the Work specified in this Section.
2. Section 260533.16 "Boxes and Covers for Electrical Systems" specifies covers and cover plates referenced by this Section.
3. Section 260923 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.2 DEFINITIONS

A. AFCI: Arc-Fault Circuit Interrupter.

B. GFCI: Ground-Fault Circuit Interrupter.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
 - a. If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
 - b. Listing criteria identified in approval letter must match specified listing criteria. UL label indicating approval of equipment's enclosure is not considered approval of equipment for intended application.
 - c. Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for discontinued or superseded products are not acceptable for submitted product.
2. Include manufacturer's sample extended warranty language.

- B. Shop Drawings:
 - 1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.
- C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra stock material.
- B. Special tools.

1.6 WARRANTY FOR DEVICES

- A. Special Installer Extended Warranty: Installer warrants that installed devices perform in accordance with specified requirements and agrees to repair or replace products that fail to perform as specified within extended-warranty period. Warranty must convey to Owner upon acceptance of the Work.
 - 1. Extended-Warranty Period: Four years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Products or components listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

- A. Toggle Switch:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell

- Incorporated
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC
- 2. Source Limitations: Obtain products from single manufacturer.
- 3. Listing Criteria: UL CCN WMUZ and UL 20.
- 4. Standard Features:
 - a. Device Color: White.
 - b. Configuration:
 - 1) General-duty, 120-277 V, 15 A, single pole three way.
 - 2) General-duty, 120-277 V, 20 A, single pole three way.
- 5. Accessories:
 - a. Cover Plate: **0.060 inch** thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC
- 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacles for Plugs and Attachment Plugs: UL CCN RTRT and UL 498.
 - b. Surge Protective Devices: UL 1449, Type 3.
- 3. Standard Features:
 - a. Device Color: White.
 - b. Configuration:
 - 1) General-duty, NEMA 5-15R NEMA 5-20R.
- 4. Other Available Features Required by the Project:

- a. Has factory-terminated connectors on wiring device pigtails for quick installation.
 - 5. Accessories:
 - a. Cover Plate: **0.060 inch** thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
 - B. Tamper-Resistant Duplex Straight-Blade Receptacle:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC
 - 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacles for Plugs and Attachment Plugs: UL CCN RTRT and UL 498.
 - b. Surge Protective Devices: UL 1449, Type 3.
 - 3. Standard Features:
 - a. Device Color: White.
 - b. Configuration:
 - 1) General-duty, NEMA 5-15R NEMA 5-20R.
 - 4. Other Available Features Required by the Project:
 - a. Has factory-terminated connectors on wiring device pigtails for quick installation.
 - 5. Accessories:
 - a. Cover Plate: **0.060 inch** thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
- 2.4 RECEPTACLES WITH ARC-FAULT AND GROUND-FAULT PROTECTIVE DEVICES
- A. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with AFCI and GFCI Device:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers

offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector
 - b. Leviton Manufacturing Co., Inc.
 - c. Pass & Seymour; Legrand North America, LLC
 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Outlet Branch-Circuit Type GFCIs and AFCIs: UL CCN KCXX, UL 498, UL 943, UL 1699, and UL Subject 1699A.
 3. Standard Features:
 - a. Device Color: White.
 - b. Configuration: Heavy-duty, NEMA 5-15R NEMA 5-20R.
 4. Other Available Features Required by the Project:
 - a. Has factory-terminated connectors on wiring device pigtails for quick installation.
 5. Accessories:
 - a. Cover Plate: **0.060 inch** thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
- B. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector
 - b. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour; Legrand North America, LLC
 2. Listing Criteria: Investigated, labeled, and marked by qualified electrical testing laboratory in accordance with guide information and standards specified for the following UL product categories:
 - a. Receptacle GFCIs: UL CCN KCXS, UL 498, and UL 943.

3. Standard Features:
 - a. Device Color: White.
 - b. Configuration: Heavy-duty, NEMA 5-15R NEMA 5-20R.
4. Other Available Features Required by the Project:
 - a. Has factory-terminated connectors on wiring device pigtails for quick installation.
5. Accessories:
 - a. Cover Plate: **0.060 inch** thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receptacles:
 1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION OF SWITCHES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturer's published instructions, comply with the following:
 1. Electrical Construction: ICC IBC, ICC IFB, NFPA 1, NFPA 70, and NECA NEIS 1.
 2. Electrical Safety: NFPA 70E.
 3. Life Safety and Means of Egress Work: NFPA 101.
 4. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
 5. Wiring Devices: NECA NEIS 130.
 6. Mounting Heights: NECA NEIS 1.
 7. Consult Architect for resolution of conflicting requirements.

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are

specified in the Contract Documents or manufacturer's published instructions, comply with the following:

1. Electrical Construction: ICC IBC, ICC IFC, NFPA 1, NFPA 70, and NECA NEIS 1.
2. Electrical Safety: NFPA 70E.
3. Grounding and Bonding: NECA NEIS 331 and Article 250 of NFPA 70.
4. Work in ITE Rooms: NFPA 75.
5. Work in Basements and Other Developed Subterranean Spaces: NFPA 520.
6. Installing and Maintaining Wiring Devices: NECA NEIS 130.
7. Mounting Heights: Unless otherwise indicated in the Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
8. Receptacle Orientation: Unless otherwise indicated in the Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
9. Consult Architect for resolution of conflicting requirements.

3.4 FIELD QUALITY CONTROL OF SWITCHES

- A. Administrant for Electrical Power Tests and Inspections:
 1. Administer and perform tests and inspections.
- B. Field tests and inspections must be witnessed by authorities having jurisdiction.
- C. Tests and Inspections:
 1. Perform tests and inspections in accordance with manufacturers' published instructions.
- D. Nonconforming Work:
 1. Unit will be considered defective if it does not pass tests and inspections.
 2. Remove and replace defective units and retest.
- E. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.5 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

- A. Administrant for Electrical Power Tests and Inspections:
 1. Administer and perform tests and inspections.
- B. Field tests and inspections must be witnessed by authorities having jurisdiction.
- C. Tests and Inspections:
 1. Insert and remove test plug to verify that device is securely mounted.
 2. Verify polarity of hot and neutral pins.
 3. Measure line voltage.
 4. Measure percent voltage drop.

5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' published instructions.

D. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.6 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.2 DEFINITIONS

- A. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing enclosed switches and circuit breakers, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 WARRANTY

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. ABB Electrification Installations Products
 - 2. Eaton
 - 3. Siemens Industry, Inc., Energy Management Division
 - 4. Square D; Schneider Electric USA
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 240 V(ac).
 - 4. 200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. ABB Electrification Installations Products
 2. Eaton
 3. Siemens Industry, Inc., Energy Management Division
 4. Square D; Schneider Electric USA
- B. Type GD, General Duty, Three Pole, Single Throw, 240 V(ac), 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: Enclosure must be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1).
- C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: Circuit-breaker operating handle must be externally operable with operating mechanism being integral part of box, not cover. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the

Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 3R.
- C. Kitchen Wash-Down Areas: UL 50E, Type 4X, .
- D. Other Wet or Damp, Indoor Locations: UL 50E, Type 4.
- E. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
 - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 - 3. Install fuses in fusible devices.

3.4 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.

- f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify correct phase barrier installation.
 - i. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:
 - a. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
 - b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - C. Nonconforming Work:
 - 1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
 - D. Collect, assemble, and submit test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.
- 3.5 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- 3.6 PROTECTION
- A. After installation, protect enclosed switches and circuit breakers from construction activities.

Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.7 MAINTENANCE

- A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.
 - 1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 262816

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Contactor-type automatic transfer switches.
 - 2. Transfer switch accessories.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Contactor-type automatic transfer switches.
 - 2. Transfer switch accessories.
- B. Product Data Submittals: For each product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- C. Shop Drawings:
 - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 - 2. Include material lists for each switch specified.
 - 3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Member company of NETA.

- a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 4 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 99.
- D. Comply with NFPA 110.
- E. Comply with UL 1008 unless requirements of these Specifications are stricter.
- F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
 2. Short-time withstand capability for three cycles.
- G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

- H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- J. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- K. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.
- L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable markers at terminations.
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 - 4. Accessible via front access.
- M. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. ABB Electrification Installations Products
 - 2. ASCO Power Technologies
 - 3. Caterpillar, Inc.; Electric Power Division
 - 4. Cummins Power Generation
 - 5. Eaton
 - 6. Generac
 - 7. Hubbell Utility Solutions; Hubbell Incorporated
 - 8. Kohler Power Systems
 - 9. Rolls-Royce Solutions America Inc.
 - 10. Russelectric, Inc
 - 11. Vertiv; Vertiv Holdings Co.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current

between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.
 2. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
 3. Conductor Connectors: Suitable for use with conductor material and sizes.
 4. Material: Hard-drawn copper, 98 percent conductivity.
 5. Main and Neutral Lugs: Mechanical type.
 6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 7. Ground bar.
 8. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Manual Switch Operation, Load-Breaking: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- F. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.
- G. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- H. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
 2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

- a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:
 - a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.

2.3 TRANSFER SWITCH ACCESSORIES

A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
 - a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
 - b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.

- c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
 - d. Transition:
 - 1) Provide open-transition operation when transferring between power sources.
 - e. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
 - f. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
 - g. Automatic and Nonautomatic Control: Automatic transfer-switch controller shall also control the bypass/isolation switch.
 - h. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
 - i. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.
4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.
- B. Remote Annunciator System:
- 1. Source Limitations: Same manufacturer as transfer switch in which installed.
 - 2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
 - 3. Annunciation panel display shall include the following indicators:
 - a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 - b. Switch position.
 - c. Switch in test mode.
 - d. Failure of communication link.
 - 4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
 - a. Indicating Lights: Grouped for each transfer switch monitored.
 - b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 - c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
 - d. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment

according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

- B. Prepare test and inspection reports.
 - 1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
 - a. Overvoltage.
 - b. Undervoltage.
 - c. Loss of supply voltage.
 - d. Reduction of supply voltage.
 - e. Alternative supply voltage or frequency is at minimum acceptable values.
 - f. Temperature rise.
 - g. Dielectric voltage-withstand; before and after short-circuit test.
 - h. Overload.
 - i. Contact opening.
 - j. Endurance.
 - k. Short circuit.
 - l. Short-time current capability.
 - m. Receptacle withstand capability.
 - n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.
- B. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to the NEC.

- E. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than **18 inches** in length.

3.3 FIELD QUALITY CONTROL

A. Administrant for Tests and Inspections:

- 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

- 1. After installing equipment, test for compliance with requirements according to NETA ATS.
- 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that the unit is clean.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - f. Verify that manual transfer warnings are attached and visible.
 - g. Verify tightness of all control connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
 - i. Perform manual transfer operation.
 - j. Verify positive mechanical interlocking between normal and alternate sources.
- 3. Electrical Tests:
 - a. Perform insulation-resistance tests on all control wiring with respect to ground.
 - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
 - c. Verify settings and operation of control devices.
 - d. Calibrate and set all relays and timers.
 - e. Verify phase rotation, phasing, and synchronized operation.
 - f. Perform automatic transfer tests.
 - g. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.

- 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
 - b. Verify time-delay settings.
 - c. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
- C. Coordinate tests with tests of generator and run them concurrently.
 - D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
 - E. Transfer switches will be considered defective if they do not pass tests and inspections.
 - F. Remove and replace malfunctioning units and retest as specified above.
 - G. Prepare test and inspection reports.
 - H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 312219 - LANDSCAPE AND FINE GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Finished Grading of Site Landscape Planting and Pedestrian Pavement Areas, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Finish grading of pavement areas.
 - 2. Sub-grade and sub-base preparation for pavement areas.
 - 3. Finish grading of landscape planting areas.
 - 4. Machinery restrictions.
 - 5. Excavation, filling and backfilling of on-site material.
 - 6. Transporting, spreading and fine grading of stockpiled site soil.
 - 7. Temporary and surface drainage.
 - 8. Prevention of excessive weed growth.
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Division 22 - Civil Stormwater Systems
 - 3. Division 31 - Civil Earthmoving and Excavations/Backfilling
 - 4. Section 32 84 00 "Landscape Irrigation Systems".
 - 5. Section 32 92 00 "Turfs, Native Grasses and Wildflowers".
 - 6. Section 32 93 00 "Landscaping".
 - 7. Section 33 43 00 "Landscape Drainage"

1.2 SITE CONDITIONS

- A. Dust Nuisance: Contractor shall assume full responsibility for alleviation or prevention of dust as a result of Work under this Section.
- B. Excessive rock, dead or declining vegetation, trash, debris, or other items that has accumulated shall be removed from the Project Site by the Contractor, and as directed by the Landscape Architect, prior to completion of Finish Grading operations.
- C. Work under this Section shall be performed only during the period when beneficial and optimum Landscape Grading results may be obtained. If the moisture content of the soil should reach such a level that working it would destroy soil structure or cause compaction, landscape grading operations shall be suspended until, in the opinion of the Landscape Architect, the moisture content is increased or reduced to acceptable levels and the desired results are likely to be obtained.

- D. Soil moisture level prior to Landscape Grading shall be no less than 75% of field capacity. The determination of adequate soil moisture for Landscape Grading shall be in the sole judgment of the Landscape Architect.

1.3 COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Complete Finish Grading prior to installation of Sprinkler Irrigation (Refer to Section 328400) in each area graded.
- B. Re-grade, as required, to acceptable Landscape Grades established by Landscape Architect once irrigation system is installed.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required.
- D. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- E. Excavation: When conditions detrimental to adequate Finish Grading operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- F. Perform Finish Grading operations only when weather and soil conditions are suitable in accordance with locally accepted practices.
- G. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective work under this Section at any time during progress of Work. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

1.4 GENERAL PROVISIONS

- A. Finished grading shall be defined as placing and grading of onsite stockpiled soil or additional soil that may be required to establish the required grades for lawns, shrub and groundcover beds.
- B. Additional fill materials shall generally be defined as on-site topsoil as specified herein.
- C. Where practicable and as directed, the use of heavy machinery shall be kept to a minimum in landscape areas. Overly compacted areas from machine access or use during previous construction shall be loosened by ripping soil to relieve compaction, not less than 12 inches deep and 12 inches on center prior to commencing landscape work except no machines are permitted in existing tree protection areas during general construction work.
- D. Work within existing tree zones:
 - 1. No fill and only limited machinery will be permitted under the canopy of existing trees to remain.
 - 2. Work shall be accomplished in tree protection areas with limited machine grading.
 - 3. Machines are allowed in tree protection zones only to the extent they are absolutely required. Limit work specifically from machine grading and generally accomplish the majority of grading and soil preparation work with hand labor within the tree protection areas.

PART 2 - PRODUCTS

2.1 FILL

- A. General Qualifications: Fill shall be a clean, dry soil of a loamy character, well drained and well graded with a plasticity index not to exceed 20 or fall below 8. Fill material shall contain no oils, alkalies, acids, rubbish or other deleterious materials. The pH shall be similar to the on-site topsoil.

2.2 TOPSOIL

- A. Topsoil material that may be required for finish grading operations shall conform to the requirements included within this Section.
- B. General Qualifications: Topsoil shall be considered acceptable which conforms to the following minimum criteria:
 - 1. Natural, friable, loamy soil, typical of local topsoil which produces heavy vegetative growth, free from subsoil, weeds, sods, stiff clay, stones larger than one (1") inch, toxic substances, debris, or other substances which may be harmful to plant growth. Do not deliver in muddy condition.
 - 2. Acidity/Alkalinity: pH 5.0 to pH 7.2.
- C. Grading Analysis:
 - 1. General Fill Material
 - a. Two (2") inch - 100 percent minimum passing.
 - b. Number 4 sieve - 90 percent minimum passing.
 - c. Number 10 sieve - 80 percent minimum passing.
 - 2. Sand, Silt, and Clay Content (from ASSHTO M146) as required and approved as being similar to existing site soil
 - a. Sand 20 to 75 percent
 - b. Silt 10 to 60 percent
 - c. Clay 5 to 30 percent
 - 3. All topsoil shall be free from all herbicides and insecticides which might adversely affect subsequent growth of turf or plantings or which might otherwise contain materials toxic to humans and pets.
- D. Non-Conforming Material: The Contractor shall not be permitted to use on-site material which does not conform to the above minimum criteria for fine grade operations. At the discretion of the Landscape Architect, such material can either be amended to meet the minimum requirements or shall be removed from the site and replaced with suitable material as specified herein.
- E. It shall be the Contractor's responsibility to verify that the existing topsoil conforms to these specifications. Topsoil determined to be non-conforming subsequent to the award of a contract shall not be means for extra compensation unless otherwise provided for herein.

- F. Soil Analysis: Obtain soil analysis of topsoil from the approved accredited agricultural testing laboratory, Wallace Laboratories, El Segundo CA, 310-615-0116., at Owner's cost. Submit results of soil analysis to the Landscape Architect for review.
- 2.3 SAND: Shall be "Sharp Sand" to A.S.T.M. C-33. Sample shall be submitted for approval. Sand shall not be permitted for fill purposes if the depth exceeds two (2") inches to achieve the finished grade.

PART 3 - EXECUTION

- 3.1 WORKMANSHIP: Work shall be performed by personnel trained and experienced in this work and shall be done under the direction of a superintendent on Contractor's staff.
- 3.2 EXCAVATION
 - A. Make excavations to relative dimensions and elevations indicated on Drawings.
 - B. Excavated material determined suitable for use as fills or topsoil may be dispersed or stored on the site in locations as directed. Excavated material unsuitable for fills shall be disposed of, legally, off site.
 - C. Where unmarked utility lines or other underground obstructions or piping may be uncovered within the work area, notify the Landscape Architect or the agencies or service utility companies having jurisdiction thereof, and take necessary measures to prevent interruption of service (if live). Should such lines or services be damaged, broken, or interrupted through the Contractor's own negligence, those services shall be repaired immediately and restored by him at his own expense. Abandoned lines, meters, and boxes, obstructions or piping shall be removed, plugged, or capped in accordance with the requirements and approval of the agencies affected, or as directed by the Landscape Architect.
 - D. Maintain all excavated areas free from water throughout progress of the work. All surface or subsurface seepage encountered shall be run to temporary sumps located where required or directed. From the sumps, water shall be pumped out and legally disposed of in a manner that will keep the entire site reasonably dry and in an accessible and workable condition at all times.
- 3.3 FILLING AND GRADING
 - A. Where existing valve boxes, water meter pits or related items are found in areas to receive fill for berms, the Contractor shall notify the Owner so that he may make any required adjustments.
 - B. The placement of fills shall be done under the supervision of the Landscape Architect.
 - C. All areas to receive fills shall be scarified to a depth of six (6") inches and moisture conditioned as required to obtain the required compaction. Where slopes exceed one vertical to four horizontal the subgrade shall be plowed, stepped, or benched in such a manner that fills will bond with base material.

- D. Fill material shall be spread in uniform lifts of not more than eight (8") inches uncompacted thickness. Prior to commencing compaction, fills shall be brought to water content that will permit proper compaction by either aerating the material if it is too wet, or spraying the material with water if it is too dry. Thoroughly mix each lift before compaction to assure uniform distribution of water content. Bring all fills to suitable elevations above grade to provide for anticipated settlement and shrinkage thereof.
- E. Fill shall not be dropped on any structure.
- F. No fill or additional soil is to be installed in any protected tree zones or within the canopy or drip line of any existing trees.
- G. No additional runoff into existing tree area or existing tree drip lines beyond the already occurring natural runoff is to be created by fill operations. Advise the Landscape Architect of conditions which will impact runoff into existing tree areas.
- H. Grade to finished grade as required by the Drawings.

3.4 COMPACTION

- A. Where fill is required, compact each layer of fill and scarify subgrade to not less than eighty five (85%) percent maximum density in planting areas and as required by the engineer in paving areas.
- B. Perform all compaction using compacting rollers, pneumatic or vibratory compactors, or other equipment and methods approved by the Owner.

3.5 PREPARATION OF SUBGRADE AND SPREADING OF TOPSOIL

- A. The subgrade soil shall be loosened to a depth of four (4") inches and graded to remove all ridges and depressions so that it will be everywhere paralleled to proposed finished grade. All stones over two (2") inches in any dimensions, sticks, rubbish and other extraneous matter shall be removed during this operation. No heavy objects except rollers shall be moved over lawn areas after the subgrade soil has been prepared before topsoil is spread.
- B. After the subgrade soil has been prepared, topsoil from the stockpile areas shall be spread evenly therein to depth of four (4") inches by an approved method and the area then rolled with a 200 pound roller. No topsoil shall be spread in a frozen or muddy condition.
- C. On all grass areas, the finished surface of the topsoil shall conform to the finished grade and shall be free from hollows or other inequalities, stones, sticks, and other extraneous matter.

3.6 FINISH GRADING

- A. In areas to receive lawns not within the canopy of existing trees, the Contractor shall till, disc, or otherwise scarify the soil, removing all clods, stones, and related material one (1") inch or larger. Place and spread any additional material that may be required. Roll completely.
- B. This Contractor shall be responsible for minor adjustments to the finished subgrade if such treatment is required in the opinion of the Landscape Architect.
- C. The Contractor may use machinery acceptable to the Landscape Architect to complete most of the work to re-establishing finished grade.

- D. Hand-rake the surface, removing all clods and undesirable material greater than one-half (1/2") inch from ground surface. Fill all low spots and cut irregularities to the acceptance of the Landscape Architect. Roll the entire surface evenly with a 200 pound water ballast roller or other means acceptable.
- E. During the finished grading operations, all swales and additional swales that may be required to drain areas where there are existing plant materials, shall be finished. In general, all grade adjustments shall be made so there are no areas that will have standing water.
- F. To prevent excessive weed growth in the lawn areas, the Contractor should be prepared to immediately install the sod upon the approved, completed and acceptable finished grade.
- G. Finish grade in existing tree areas which are to be graded shall be accomplished by light hand raking to a depth of 1/2" maximum and smoothing the area. No other grading, fill or other leveling is to occur.

END OF SECTION

SECTION 321313 - LANDSCAPE ARCHITECTURAL CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make a complete Site Cement Concrete Paving installation, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Cast-in-Place Concrete Ramps
 - 2. Cast-in-Place Concrete Curbs
 - 3. Cast-in-Place Concrete Sub-slabs
 - 4. Jointing (Expansion Joints, Contraction Joints, Isolation Joints, Keyway/Construction Joints and/or Architectural Score Joints)
 - 5. Joint Sealants
 - 6. Steel Reinforcement
 - 7. Steel Dowels and Sleeves
 - 8. Compacted Sub-Surface Materials.
 - 9. Concrete Pavement Finishes.
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 09 63 41 "Site Stone Paving"
 - 3. Section 09 93 00 "Site Exterior Tiling"
 - 4. Section 32 13 16 "Architectural and Decorative Cement Concrete Paving".
 - 5. Section 32 13 23 "Cast-in-Place Concrete for Landscape Elements".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
 - 3. ACI – American Concrete Institute.
 - 4. PCA – Portland Cement Association.
 - 5. CRSI – Concrete Reinforcing Steel Institute.
 - 6. UBC – Uniform Building Code.
 - 7. NRMCA – National Ready Mix Concrete Association.
 - 8. ADAAG – American with Disabilities Act Accessibility Guidelines.

9. TAS – Texas Accessibility Standards

B. Definitions:

1. Cementitious Materials: Portland Cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
2. Percent Compaction: Per ASTM D1557, percentage of the maximum in-place dry density of the same material, as determined by Geotechnical Engineer.
3. Low Carbon Concrete: Concrete that is designed with the intent of reducing the carbon footprint when compared to traditional concrete. The carbon footprint is reduced by the option of alternative cement types, the replacing cement content with supplementary cementitious materials (SCMs), using recycled concrete aggregate (RCA), chemical add mixtures, performance base concrete and using alternate fuel source to that power batch plant and transportation vehicles. In this specification LCC will be measured by the GWP Cap value or cement limits as define in the concrete mix designs.
4. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
 - a. Portland Cement: Meet ASTM C150.
 - 1) Cement Type: Type I
 - 2) Cement Type: Type II/V
 - 3) Cement Type: Type III
 - b. Hydraulic Blended Cement: Meet ASTM C595
 - 1) Type 1L Portland-Limestone Cement (PLC):
 - a) PLC may contain anywhere from 5% to 15% limestone.
 - b) Portland Limestone Cement lowers the CO2 by 8-12% per Ton of Cement
 - c) PLC complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - 2) Type 1S Portland-Slag Cement
 - a) Complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - 3) Type 1P Portland Pozzolan Cement
 - a) Complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - 4) Type 1T Ternary Blended Cements
 - a) Complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - c. ASTM C1157 Cement Performance Types:
 - 1) Type MS: Moderate Sulfate Resistance
 - 2) Type LH: Low Heat of Hydration
 - 3) Type GU: General Use
 - 4) Type HE: High Early-Strength
 - 5) Type HS: High Sulfate Resistance
 - 6) Type MH: Moderate Heat of Hydration
 - d. Supplementary Cementitious Materials (SCM): An SCM is defined by ASTM International as “an inorganic material that contributes to the properties of a

cementitious mixture through hydraulic or pozzolanic activity, or both” (2015 ASTM).

- 1) Fly Ash: Flyash: Pozzolanic admixtures, conforming to ASTM C618, Class C or Class F, with weight loss of ignition limited to not to exceed 3 percent shall be used in mix designs to replace Portland Cement. Final replacement value to be determined by the ready-mix plant and shall be coordinated with the use of PLC Type IL MS/LH, ASTM C595 Compliant.
- 2) Ground Granulated Iron Blast-Furnace Slag: Meet ASTM C989.
- 3) Silica Fume: Meet ASTM C1240
- 4) Natural Pozzolans: Meet ASTM C618
- 5) Reference: ACI 211.4R-93.
5. Recycled Concrete Aggregate (RCA): Recycled concrete aggregate (RCA) comes from the processing of concrete from either previous infrastructure projects or waste concrete left over from placements. The concrete is crushed into a material of a specified size and quality.
6. GWP: Global Warming Potential: The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO₂). The larger the GWP, the more that a given gas warms the Earth compared to CO₂ over that time period. The time period usually used for GWPs is 100 years. GWPs provide a common unit of measure, which allows analysts to add up emissions estimates of different, and allows policymakers to compare emissions reduction opportunities across sectors and gases. (GWP as defined by the US EPA)
7. EPD: Environmental Product Declaration: Type III environmental declarations present quantified environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function. Such declarations 1. are provided by one or more organizations, 2. are based on independently verified life cycle assessment (LCA) data, life cycle inventory analysis (LCI) data or information modules in accordance with the ISO 14040 series of standards and, where relevant, additional environmental information, 3. are developed using predetermined parameters, and 4. are subject to the administration of a program operator, such as a company or a group of companies, industrial sector or trade association, public authorities or agencies, or an independent scientific body or other organization

C. Standards of Construction:

1. ACI 214 – Recommended Practice for Evaluation of Strength Tests Results of Concrete.
2. ACI 301 – Details and Detailing of Concrete Reinforcement.
3. ACI 305 – Recommended Practices for Cold Weather Concreting.
4. ACI 306 – Recommended Practices for Hot Weather Concreting.
5. ACI 308 – Standard Practice for Curing Concrete.
6. ACI 347 – Recommended Practice for Concrete Formwork.
7. ASTM A185 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
8. ASTM C33 – Specification for Concrete Aggregates.
9. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
10. ASTM C94 – Specification for Ready-Mix Concrete.

11. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregate.
12. ASTM C143 – Test Method for Slump of Portland Concrete Cement.
13. ASTM C150 – Specification for Portland Cement.
14. ASTM C260 – Air-Entraining Admixtures for Concrete.
15. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
16. ASTM C494 – Chemical Admixtures for Concrete.
17. ASTM C595- Standard Specification for Blended Hydraulic Cements
18. ASTM A615 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
19. ASTM D1751 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).
20. National Ready Mix Concrete Association, latest revision: "Certificate of Conformance for Concrete Production Facilities".
21. ASTM C1157 – Standard Performance Specification for Hydraulic Cement.
22. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
23. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars
24. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures

D. Measurements:

1. PSI: Measurement, in pounds per square inch.
2. SF/FT: Measurement, in square-foot.
3. CU/YD: Measurement in cubic-yard.
4. Kg CO2e: Measurement, in kilograms of carbon dioxide equivalent.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or

poor drafting quality; or if all of the required information is missing or not presented in the format as requested.

- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Product/Material Data: Submit Manufacturers' current available Product Data catalog cuts sheets, specifications, and manufacturing sources for each type of material and product indicated herein this Article (as applicable). Data shall also include source and/or Manufacturer's name, address, and telephone numbers.
 - 1. Reinforcement and Forming Accessories, and Certificate of compliance.
 - 2. Joint Systems: Expansion joint filler, sealant, backer rod and bond breaker. (provide physical samples of the sealant for color selection)
 - 3. Curing Compound.
 - 4. Standard Specification for Blended Hydraulic Cements: Type 1L Portland-Limestone Cement (PLC): ASTM C595 / AASHTO M240
 - a. Type 1S Portland-Slag Cement: ASTM C595 / AASHTO M240
 - b. Type 1P Portland Pozzolan Cement: ASTM C595 / AASHTO M240
 - c. Type 1T Ternary Blended Cements: ASTM C595 / AASHTO M240
 - 5. Sealer
 - 6. Statement of Mix Design, prepared by the batch plant servicing the Project, for each type or load delivered to Project. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Each Statement of Mix Design shall include following information:
 - a. Name, address, and telephone number of batch plant preparing Statement of Mix Design.
 - b. Date of Mix Design.
 - c. Project location.
 - d. Contractor requesting load delivery.
 - e. Mix Design Number.
 - f. Cement Type and quantity by volume
 - g. SCM - Post-industrial pozzolan (Fly ash, slag, ground limestone, natural pozzolan) cement substitution as a percentage of the full product composite by volume.
 - h. Admixtures (as required).
 - i. Integral Color Admixtures (as required).
 - j. Gradations for sand and aggregate and RCA content, indicate content by percentage by volume.
 - k. Material weights, specific gravity, and absolute volumes.
 - l. Basis of testing, i.e. UBC 2605 D4 and CBC Title 24 2604 D4.
 - m. Water/Cement Ratio.
 - n. Slump.
 - o. PSI rating.
- H. EPD Information for Concrete Mix Design (As Available per Ready Mix Plant)
 - 1. EPD Submittal:
 - a. Completed Environmental Product Declaration Reporting Form for each concrete mix design.

- b. For products with completed Environmental Product Declaration Reporting Forms claiming availability of an applicable EPD, provide the Product-Specific or Industry-Wide Type III Environmental Product Declaration (EPD) in compliance with ISO 14025.
 - c. GWP Range: Per mix design
- I. Low Carbon Concrete Compliance
 - 1. This submittal shall indicate the concrete compressive strengths with cement limits measured in lbs/cubic yard per mix design.
 - 2. Low Carbon Concrete Compliance shall be provided when EPD's are not available.
- J. Material Test Reports: Signed and stamped laboratory test reports for evaluation of concrete materials and mix design tests.
- K. Material Samples: Samples of the material items indicated herein this Section shall be furnished for review and approval. Submit two (2) sets of samples that are consistent with the specified products for each item indicated:
 - 1. One (1) 10-pound sample of each Aggregate and sand.
 - 2. Six-inch (0'-6") section of each Joint Sealant material.
- L. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Concrete Paving installations. Include lists of completed projects with project names and addresses, names and addresses of Architects/Landscape Architects, Artists and Owners, and other information specified.
- M. Submittals for Environmental Performance
 - 1. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate.
 - 2. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.
 - 3. Provide product data stating the location where all products were manufactured and where the raw materials were harvested, extracted or recovered.
 - 4. For projects using FSC certified formwork, provide chain-of-custody documentation for all certified wood products.
 - 5. For projects using reusable formwork, provide data showing how formwork is reused.
 - 6. Provide MSDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.
 - 7. Provide MSDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.
- N. Field-Constructed Mock-up Samples:
 - 1. General: Prior to the installation of Work under this Section, Contractor shall erect Field-Constructed Mock-up Samples for each type and pattern of Concrete Paving required for review and approval by the Landscape Architect, to verify selections made under the referee samples obtained by the Landscape Architect.

2. Build Field-Constructed Mock-up Samples to comply with the following requirements, using materials and same base construction including special features for form work, jointing, surface finishes, textures, color(s), and contiguous Work as indicated for the final unit of Work.
 - a. Locate Field-Constructed Mock-up Samples on the Project Site in location(s) as directed by the Owner.
 - b. Notify the Landscape Architect, in writing, at least five (5) days in advance of the dates and times when Field-Constructed Mock-up Samples will be erected.
 - c. Demonstrate quality and range of aesthetic effects and workmanship in the Field-Constructed Mock-up Samples that will be produced in final unit of Work.
 - d. Obtain the Landscape Architect's acceptance of Field-Constructed Mock-up Samples, in writing, before start of installation of Work.
 - e. Retain and maintain Field-Constructed Mock-up Samples during construction in an undisturbed condition as a standard for judging the completed unit of Work.
 - f. When directed by the Owner, Contractor shall demolish and remove Field-Constructed Mock-up Samples from Project Site.
 3. Size: Each Field-Constructed Mock-up Sample within this Section shall measure a minimum of six-feet (6'-0") wide x six-feet (6'-0") long to compare the aesthetics of material colors, textures, and finishes.
 4. When the Landscape Architect determines that a Field-Constructed Mock-up Sample does not meet acceptable requirements, retain it for reference and cast another Field-Constructed Mock-up Sample (as required) until the Sample is accepted.
 5. Accepted Field-Constructed Mock-up Samples will be the standard by which Work under this Section will be evaluated for technical and aesthetic merit. Accepted Field-Constructed Mock-up Samples are the prerequisite to the commencement of Work.
- O. Pre-installation Conference: Conduct conference at project site.
1. Review methods and procedures related to decorative concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and decorative concrete paving construction practices.
 2. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Decorative concrete paving Installer.
 - d. Manufacturer's representative of decorative concrete paving system.

1.4 QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications: Engage an experienced Installer who has completed in the last two (2) years at least three (3) concrete paving installations similar in material, design, and extent to that indicated for this Project, and whose work has resulted in construction with a record of successful in-service performance.
- B. Applicable Standards of Work:

1. Applicable specifications and recommended practices of American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), The Uniform Building Code, with their individual designations, are to be considered part of this Specification. Refer to "Standards of Construction" under "Definitions & Applicable Standards" Article herein this Section.
 2. Design and Control of Concrete Mixture, Thirteenth Edition, Portland Cement Association.
 3. Manual of Standard Practice, Concrete Reinforcing Steel Institute (CRSI).
 4. Sealants: The Professional's Guide, Sealant, Waterproofing & Restoration Institute (SWRI).
- C. Single-Source Responsibility: Obtain each color, type, and variety of cementitious materials, aggregates (coarse and fine), chemical admixtures, water source, jointing materials, and other materials, from a single source, with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
- D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated, as documented according to ASTM E548.
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.
- F. Lines and Levels: To be established by a licensed Surveyor or registered Civil Engineer.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials in a timely manner to ensure un-interrupted progress of the Work.
 - B. Store materials in a dry and protected location. Protect reinforcing steel and dowels from rusting, deformation, staining, and moisture damage.
 - C. Store materials by methods that prevent damage and permit ready access for inspection and identification. Package cement delivered to the Project Site shall be in strong paper or jute bags with brand name and manufacturer's name stamped thereon. Store cement under cover. Remove packaged cement immediately from the Project Site should it become wet or show any signs of caking or deterioration.
 - D. Keep surface seeded/finishing materials dry prior to installation, as required.
- 1.6 PROJECT SITE CONDITIONS
- A. Traffic Control: Maintain access for vehicular, bicycle, and pedestrian traffic as required for other construction activities. Access to the surrounding buildings shall also be unobstructed and maintained at all times to allow for entry and exit of emergency vehicles.

- B. Establish and maintain required levels and grade elevations. Review installation procedures and coordinate Work herein this Section with other Work affected.
- C. Do not place concrete during rain or adverse weather conditions without means to prevent damage. Conform to requirements specified hereinafter whenever concrete placement is required during cold or hot weather.
- D. Water and Dust Control: Maintain control of concrete dust and water during duration of Contract. Do not permit adjacent planting areas to be contaminated. Clean up debris resulting from this work at the end of each day's work.

1.7 COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Sequence and Scheduling: Notify contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place, such as:
 - 1. Irrigation pipe sleeves under paving. Refer to Section 328400 – Irrigation Systems.
 - 2. Accessories embedded in the concrete, and for the provision of holes, openings, etc., necessary to the execution of the Work of the trades.
 - 3. Future or other trade sleeves under paving.
 - 4. Utility crossings.
- B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- D. Excavation: When conditions detrimental to adequate installation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- E. Environmental Conditions: Perform installation operations only when weather and soil conditions are suitable in accordance with locally-accepted practices.
- F. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

- G.
- H.
- I.
- J.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, wood, MDO plywood, metal, metal-framed plywood, or other approved panel-type materials, of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
 - 1. Provide Forms that are full-depth, continuous, straight and free of distortions and defects, and level or sloping along exposed surfaces.
 - 2. Provide Forms of sufficient strength and durability to hold concrete properly in place and prevent leakage of water from Forms.
 - 3. Use flexible spring forms, laminated boards, or foam forms to form continuous and smooth radius bends, as required.
 - 4. No wood-textured finish from Forms will be permitted on exposed concrete unless specified as such.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments and finishes of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Deformed-Steel Welded Wire Reinforcement (to 70,000psi): Meet ASTM A497, flat sheet. Rolls are not acceptable.
 - 1. Provide material manufactured from 80-100% post-consumer recycled-content materials.
- B. Steel Reinforcement Bars: Meet ASTM A615, Grade 60 deformed, clean and free of rust, dirt, grease or oils.
 - 1. Provide material manufactured from 80-100% post-consumer recycled-content materials.
- C. Steel Bar Mats: Meet ASTM A184 with ASTM A615, Grade 60 deformed bars; assembled with clips.
 - 1. Provide material manufactured from 80-100% post-consumer recycled-content materials.

- D. Steel Tie Wire: 16-gauge minimum, black annealed, plain cold-drawn steel conforming to ASTM A82, clean, and free of rust, dirt, grease or oils.
- E. Construction/Expansion Joint Dowel Bars & Slip Dowel Sleeves:
 - 1. Slip Dowel Sleeve System: A reusable base and plastic sleeve, manufactured from polypropylene plastic. Encase fifty percent (50%) of each dowel in a plastic sleeve to allow parallel lateral movement of each Dowel. Size of Sleeve to match size of Dowel.
 - a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) Speed Dowel, Greenstreak.
 - 2) or equal (no known equal).
 - b. All dowels shall be held in place prior to pour with dowel chairs
- F. Snap Ties: Snap-off metal of fixed length capable of leaving no metal within 1 1/2 in. of surface or causing fractures, spall, or other defects larger than one (1) in. diameter.
- G. Hook Bolts: ASTM A307, Grade A internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- H. Supports for Reinforcement: Lightweight, strong, non-corrosive, durable, and impervious to water. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place, as manufactured from 100% recycled-content plastic or engineered resins from recycled ABS plastic, polycarbonates, and fiberglass.

2.3 CONCRETE MATERIALS

- A. Hydraulic Blended Cement: Meet ASTM C595. Use one (1) brand of cement (single source) throughout the Project, unless otherwise acceptable to the Landscape Architect. Contractor shall verify the cement color with the Landscape Architect. Cement Types as follow:
 - 1. Cement Type: Type IL Portland-Limestone Cement
 - 2. Cement Type: Type IS Portland-Slag Cement
 - 3. Cement Type: Type IP Portland-Pozzonlan Cement: Portland-pozzolan cement with moderate sulfate resistance properties
 - 4. Cement Type: Type IT Ternary Blended Cement
- B. ASTM C1157 Cement Performance Types:
 - 1. Type MS: Moderate Sulfate Resistance
 - 2. Type LH: Low Heat of Hydration
 - 3. Type GU: General Use
 - 4. Type HE: High Early-Strength
 - 5. Type HS: High Sulfate Resistance
 - 6. Type MH: Moderate Heat of Hydration

- C. Portland Cement: Meet ASTM C150. Use one (1) brand of cement (single source) throughout the Project, unless otherwise acceptable to the Landscape Architect. Contractor shall verify the cement color with the Landscape Architect. Cement Type as follows:
1. Cement Type: Type I.
 2. Cement Type: Type II/V.
 3. Cement Type: Type III.
- D. Aggregate: ASTM C 33, uniformly graded, from a single source, gray in color only, with coarse aggregate as follows:
1. Class: 4M.
 2. Maximum Aggregate Size: 3/4 inch nominal.
 3. Do not use fine or coarse aggregates containing substances that cause spalling.

- E. Normal-Weight Recycled Concrete Aggregates (RCAs): Meet ASTM C33, Class 1N, and as follows:

1. Fine Aggregates: Meet ASTM C33, clean, hard, non-reactive, and durable sand. Do use sand coated with injurious amounts of silt, loam, clay or other deleterious matter.

2. Grading Requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100%
No. 4	95-100%
No. 8	80-100%
No. 16	50-85%
No. 30	25-60%
No. 50	5-30%
No. 100	0-10%

3. Coarse Recycled Concrete Aggregates: Meet ASTM C33, hard, durable, non-reactive, uncoated, graded, cleaned, and screened crushed rock or gravel aggregate for regular weight concrete. Do not use crusher-run stone or bank-run gravel. Aggregate shall be from a single source and shall be like in visual appearance.

- a. Grading: Do not use Coarse Aggregate which has a maximum size exceeding 1/5 of the narrowest dimension between sides of forms of the member for which concrete is to be used, nor larger than 3/4 of the minimum clear spacing between reinforcing bars.

- 1) Do not use coarse Aggregate for pavements which exceeds 3/4 inch diameter.

- 2) Do not use coarse aggregates that contain substances that cause spalling.

4. Fine Recycled Concrete Aggregate:

- a. Description: ASTM C33, clean, hard and durable sand. Do not use sand coated with injurious amounts of silt, loam, clay or other deleterious matter.

- b. Grading Requirements:

<u>Percent Passing</u>	<u>Sieve Size</u>
45-70	# 16
15-30	# 50
3- 8	#100

- c.

- d. Local aggregates not complying with ASTM C33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to the Landscape Architect.
- F. Supplementary Cementitious Materials (SCM):
 - 1. Fly Ash: Flyash: Pozzolanic admixtures, conforming to ASTM C618, Class C or Class F, with weight loss of ignition limited to not to exceed 3 percent shall be used in mix designs to replace Portland Cement. Final replacement value to be determined by the ready-mix plant and shall be coordinated with the use of PLC Type IL MS/LH, ASTM C595 Compliant.
 - 2. Ground Granulated Iron Blast-Furnace Slag: Meet ASTM C989.
 - 3. Silica Fume: Meet ASTM C1240
 - 4. Natural Pozzolans: Meet ASTM C618
 - 5. Reference: ACI 211.4R-93.
- G. Water: Per ASTM C1602, from potable domestic source, free from deleterious materials such as oils, acids, and organic matter.

2.4 CHEMICAL ADMIXTURES FOR CONCRETE

- A. General: Admixtures shall be certified by the Manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other Admixtures. Use of Admixtures shall not relieve the Contractor of the designated concrete requirements, including strength.
- B. Air-Entraining Admixture: Meet ASTM C260.
- C. Water-Reducing Admixture: Meet ASTM C494, Type A.
- D. Water-Reducing and Set Retarding Admixture: Meet ASTM C494, Type B and D.
- E. Shrinkage-Reducing Admixture: Meet ASTM C157. Provide at dosage of 2% by weight of cement.
- F. Integral Concrete Coloring Admixture: Provide materials specifically designed for use in ready-mix concrete, from a single source, and shall be like in color and visual appearance. Meet ASTM C979. Refer to Section 32 1316 "Decorative Concrete Paving".

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces / square yard dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

- D. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- E. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Clear Waterborne Membrane-Forming Curing Compound which will not affect the final surface color or finish:

2.6 RELATED MATERIALS

- A. Expansion Joint Materials:
 - 1. W.R. Meadows or equal, Ceramar flexible foam expansion joint 1/4 inch
 - 2. Metal keyway with 1/4 inch pull strip and foam expansion material.

2.7 CONCRETE MIXES AND PROPORTIONING

- A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength for each type of normal-weight concrete in accordance with current edition of ACI's "Manual of Concrete Practice" and the PCA's "Design and Control of Concrete Mixtures".
 - 1. Use transit mixer trucks equipped with automatic devices for recording number of revolution of drum.
- B. Slump: Adjust quantity of water so concrete at point and time of discharge does not exceed the aforementioned slumps when tested per ASTM C143. Use the minimum water necessary for workability required by part of item being cast.
- C. Proportion Concrete Mixes to provide Low Carbon Concrete with the following properties:
 - 1. Vehicular Paving Use Areas:
 - a. Compressive Strength (28 Days): Minimum 4,000 PSI.
 - b. GWP Cap: 300 kg CO₂e /m³ (as verified by concrete submittal) , and/or
 - c. Cement Limit (lbs/cubic yard): 456
 - d. Maximum Water-Cementitious Materials Ratio: 0.45.
 - e. Slump Limit: 4 inches.
 - 2. Pedestrian Paving Use Areas and Stairs:
 - a. Compressive Strength (28 Days): Minimum 3,000 PSI.
 - b. GWP Cap: 275 kg CO₂e /m³ (as verified by concrete submittal) , and/or
 - c. Cement Limit (lbs/cubic yard): 410
 - d. Maximum Water-Cementitious Materials Ratio: 0.45.
 - e. Slump Limit: 5 inches.
- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials (other than Portland Cement) in concrete as follows"
 - 1. Supplemental Cementitious Material (SCM) for Low Carbon Concrete (LCC): Final type and weight of cementitious replacement materials to be provided by the Ready-Mix Plant. SCMs used shall help to meet the GWP cap as noted in the mix design reequipments.

- a. GGBFS: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
- b. Pozzolans: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - 1) Fly Ash: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - 2) Natural Pozzolan: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - 3) Silica Fume: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
- E. Add Air-Entraining Admixture at the Manufacturer's prescribed rate to result in concrete at point of placement. If used, do not exceed two-percent (2%).
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 1.5 percent:
 - 1. Air Content: 5.5 percent for 1-1/2-inch maximum aggregate.
 - 2. Air Content: 6.0 percent for 1-inch and 3/4-inch maximum aggregate.
- G. Shrinkage Reducing Admixture at 1 gallon used per cubic yard of concrete to reduce cracking.
- H. Coloring Agent: Add coloring agent to mix according to Manufacturer's written instructions. See drawings for color and manufacture information.
- I. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.
- J. Concrete Delivery: Use of concrete loads exceeding ninety (90) minutes from time of batch plant must be approved by the Landscape Architect
- K. Ensure that the batch plant guarantees a single-source supply for Cement, Sand, and Aggregate for the entire project.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C94.
- B. When air temperature is between 85 deg. F. (30 deg. C.) and 90 deg. F. (32 deg. C.), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F. (32 deg. C.), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

3.2 EXAMINATION

- A. Examine exposed sub-grades and sub-base surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Surface Drainage:
 - 1. Report in writing conflicts discovered on the site or prior Work done by others, which would prevent positive drainage.
 - 2. Do not permit finished paving surfaces to vary more than 1/4 in. measured with a 10 ft. metal straightedge, except at grade changes.
 - 3. No "birdbaths" or other surface irregularities shall be permitted. Properly correct irregularities.

3.3 PREPARATION

- A. Templates: Use templates for anchor plates, bolts, inserts and/or other items embedded in concrete. Accurately secure so that they will not be displaced during placing of concrete.
- B. Piping and Conduit: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain strength of structures at maximum. Verify size, length and location of electrical conduit.
- C. Aggregate Base Course: Compact base course to thicknesses as shown on Contract Drawings or as indicated per the Geotechnical Report, to the relative compaction density as required per the Geotechnical Report. Aggregate Base Course shall be graded to the lines and levels indicated; no ruts or depressions shall be allowed.
- D. Gravel Fill or Sand Beds: Re-compact disturbed gravel fill or sand beds and bring to correct elevation.

3.4 FORMWORK

- A. Design, construct, erect, shore, brace, and maintain Formwork according to ACI 347 "Guide to Formwork for Concrete."
- B. Contact Landscape Architect after form placement and prior to placement for review and field adjustment to form work.
- C. Formwork shall be consistent with the orientation and pattern indicated on the Contract Drawings. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to

required lines, grades, and elevations. Install Formwork to allow continuous progress of Work and so that Formwork can remain in place at least twenty-four (24)-hours after concrete placement.

- D. Coordinate locations of drainage piping requirements, irrigation piping stub-outs, electrical conduits, or other items scheduled to be embedded into cast concrete.
- E. Check completed Formwork and screeds for grade and alignment to following tolerances:
 - 1. Top of Forms: Not more than 1/8 inch in ten- (10) feet.
 - 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in ten-(10) feet.
- F. Coat Formwork with Form Release Agent, as required, to ensure Formwork separates from cast concrete without damage to concrete.
 - 1. Formwork surfaces shall be clean, dry, and free from contaminants (dirt, dust, rust, build-up, and existing form agents) prior to each use of Formwork
 - 2. Prior to each use, Formwork that comes into direct contact with concrete shall be coated with Form Release Agent in accordance with the Manufacturer's written instructions.
 - 3. Apply Form Release Agent in a uniform and even manner by low pressure spray, roller, or clean cloth, in accordance with the Manufacturer's written instructions.
 - 4. Prior to coating new Formwork, apply one (1) or two (2) heavy coats to edges for waterproofing protection.
 - 5. Excess Form Release Agent or dense form surfaces should be removed with a clean cloth.
 - 6. Do not apply Form Release Agent to reinforcing steel.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E.
- F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.6 CONCRETE PLACEMENT

- A. Preparation: Remove all free water from forms before concrete is deposited. Remove hardened concrete, debris, and foreign materials from interior surfaces of forms, exposed reinforcing, and from surfaces of mixing and conveying equipment.
- B. Sub-Base: Sub-Base shall be free of ruts, holes, ridges, etc. Smooth and compact sub-base to an even plane.
- C. Wetting: Wet wood forms sufficiently to tighten up cracks. Wet other materials sufficiently to reduce absorption and to help maintain concrete workability. Dampen earth sub-grade twenty-four (24) hours before placing concrete, but do not muddy. Re-roll where necessary for smoothness, and remove loose material from compacted sub-base surface prior to placing concrete.
- D. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, dowels/sleeves, and items to be embedded or cast in. Notify other trades to permit installation of their Work.
 - 1. Reinforcement and Forms shall be secured firmly in position such that they will not be displaced during the placement of concrete.
 - 2. Reinforcement Bars, Ties, and Welded Wire Reinforcement shall be completely encased in concrete, at a maximum of two-inches (2") from the edge of the concrete.
 - 3. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- E. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
- H.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- I. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained eighty-five-percent (85%) of its fully hydrated compressive strength.
- J. Cold-Weather Placement: Comply with ACI 306.1, and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg. F. (4.4 deg. C.), uniformly heat water and aggregates before mixing to obtain a concrete mixture

- temperature of not less than 50 deg. F. (10 deg. C.) and not more than 80 deg. F. (27 deg. C.) at point of placement.
2. Do not use calcium chloride, salt, or other materials containing anti-freeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- K. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg. F. (32 deg. C.). Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, reinforcement steel, and sub-grade just before placing concrete. Keep sub-grade moisture uniform without standing water, soft spots, or dry areas.

3.7 JOINTS

- A. General: Refer to ACI 302 "Guide for Concrete Floor and Slab Construction" for work under this Article. Construct construction, isolation, expansion, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
1. When joining existing paving, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half (1/2) hour, unless paving terminates at isolation joints.
1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated on the Contract Drawings.
 2. Provide tie bars at sides of paving strips where indicated.
 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, buildings, foundations, walls, other fixed objects, and in other locations as indicated on the Contract Drawings. Provide Expansion Joints at full depth of concrete paving where paving meets the vertical faces of buildings, structures, foundations, walls, etc.
1. Locate expansion joints at maximum intervals of twenty (20) feet, unless otherwise indicated on the Contract Drawings.
 2. Extend joint fillers full width and depth of joint.
 3. Provide Construction Joint Dowel Bars at the spacing distances indicated in the Contract Drawings.
 4. Terminate Joint Filler less than 1/2 inch or more than one-inch (1") below finished surface if joint sealant is indicated.

5. Place top of Joint Filler flush with finished concrete surface if joint sealant is not indicated.
 6. Furnish joint fillers in one (1)-piece lengths. Where more than one (1) length is required, lace or clip joint-filler sections together.
 7. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints and Isolation Joints: Form weakened-plane contraction joints and isolation joints, sectioning concrete into areas as indicated on the Construction Drawings, or at spacing intervals as recommended by the PCA.
1. General Methodology: Contraction Joints shall be placed in Concrete Paving to minimize the occurrence of random cracking on the surface due to drying shrinkage or stress loading and to reduce the width of concrete cracks should they occur. When not indicated on the Contract Drawings, Contraction Joints shall be placed at 24x the thickness of the concrete paving.
 2. Tooled (Grooved) Contraction Joints:
 - a. Form Tooled (Grooved) Joints in fresh concrete after initial floating using a jointer to cut the groove so that a smooth, uniform impression is obtained. Strike joints before and after floating and troweling.
 - b. Perform in a continuous operation to avoid misalignment of joints. Use snap-lines and forms, as required, to achieve consistent lines. Re-form crooked or misaligned joints at no cost to Owner.
 - c. Tooled Radius of Joint Tool
 - 1) Radius: 1/8 inch.
 - d. Depth: Construct depth equal to a minimum of one-fifth (1/5) of the concrete slab thickness.
 3. Saw-Cut Contraction Joints:
 - a. Construct Saw-Cut Contraction Joints with a circular power saw, equipped with a new, shatterproof abrasive or diamond-tipped blade. Cut 3/16-inch-wide joints (maximum width of saw-blade) into concrete surface. Cutting action shall not tear, abrade, spall, shatter, or otherwise damage the surface.
 - b. Saw-cut concrete surface when successful jointing results can be achieved and prior to uncontrolled random contraction cracking of concrete occurs.
 - 1) Early-entry Sawcuts: When used, provide sawcuts into fresh concrete as indicated on the Contract Drawings.
 - c. Perform saw-cut joints cleanly and smoothly, to a constant and equal depth, in a continuous consistent line, with no over-cutting.
 - d. Depth:
 - 1) Contraction Joints: Construct depth equal to a minimum of one-fifth (1/5) of the concrete slab thickness.
 - 2) Isolation Joints: Construct depth equal to the full depth of the concrete thickness.
 - e. Perform in as continuous an operation as possible, to avoid misalignment of joints. Use chalk lines, forms, or templates as required, to achieve consistent lines.

- f. Use a hand grinder with a 4-inch diamond blade to saw-cut up to vertical edges such as walls, steps, curbs and columns. Do not over-cut into vertical surfaces or adjacent concrete surfaces.
- E. Edging: Tool edges of pavements, gutters, headers, curbs, joints in concrete, and other locations, as required, after initial floating, with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
 - 1. Radius: as indicated on the Contract Drawings

3.8 CONCRETE FINISHES

- A. General:
 - 1. Finished pavement surfaces indicated herein this Section shall be "slip-resistant", per the requirements outlined in and per ADAAG 4.5.1.
 - a. The minimum coefficient of friction shall meet or exceed 0.8 on exterior and 0.6 on interior surfaces.
 - b. Pavement surfaces shall have the following finish on all surfaces less than six percent (6%) slope:
 - 1) Medium Broom Textured Finish, or a textured finish as specified which is equivalent to the finished texture of a Medium Broom Textured Finish.
 - c. Pavement surfaces shall have the following finish on all surfaces greater than six percent (6%) slope:
 - 1) Heavy Broom Textured Finish, or a textured finish as specified which is equivalent to the finished texture of a Heavy Broom Textured Finish.
 - d. Color(s) and finish(es) specified herein shall match referee samples and field-constructed mock-up samples as approved by the Landscape Architect.
 - e. Wetting of concrete surfaces during screeding, initial floating, or finishing operations is strictly prohibited.
- B. Broom-Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.
 - 1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
 - 2. Texture:
 - a. Fine-to-Medium-Textured Broom Finish: Provide a fine-to-medium texture finish by striating the freshly-cast float-finished concrete surface with a soft bristle broom, perpendicular to line of traffic, to provide a uniform, consistent, fine-line texture.
 - b.
 - c.
 - d.
 - e. Medium-to-Coarse-Textured Broom Finish: Provide a medium-to-coarse-texture finish by striating the freshly-cast float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic, to provide a uniform, consistent, coarse-line texture.

3. Provide contraction jointing and edging, as required, in the locations indicated in the Contract Drawings, and of the type(s) indicated herein this Section. Early-entry jointing of concrete may be required to prevent premature cracking of finished surfaces.
4. After concrete is fully hydrated (approx. 30-days), seal broom texture finished concrete surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
 - a. Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for Sealer requirements.

3.9 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

3.10 INSTALLATION OF JOINT SEALANTS

- A. Provide a Joint Sealant that is compatible with the substrate material(s) to which it is being applied. Do not use a Joint Sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the application tool.
- B. Ambient Temperature Criteria: The ambient temperature shall be within the limits of 40d. F. and 90d. F. when the Joint Sealant is being applied.
- C. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of Joint Sealants as applicable to materials, applications and conditions indicated.
- D. Surface Preparation of Joints:
 1. Remove foreign material from joint substrates which could interfere with adhesion of Joint Sealant, including dust, surface dirt, dirt, moisture, water repellents, grease, oil, wax, lacquer, paint, waterproofing, or other foreign matter that would tend to destroy or impair adhesion.
 2. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths.
 3. Clean porous surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or acid washing to produce a clean, sound substrate. Remove loose particles remaining from cleaning operations by vacuuming or blowing out joints.
 4. Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing.
 5. Clean non-porous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of Joint Sealants.

- E. Sealant Preparation: Do not add liquids, solvents, or powders to the Joint Sealant material (for single-component materials). Where specified, mix multi-component elastomeric Joint Sealants in accordance with manufacturer's instructions.
- F. Primer: Immediately prior to application of the Joint Sealant, clean out loose particles from joints. Where recommended by the sealant manufacturer, apply Primer to joints in accordance with sealant manufacturer's instructions. Do not apply Primer to exposed finish surfaces. Do not allow spillage or migration of Primer onto adjoining surfaces.
- G. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
 - 1. Install Joint Fillers to provide sealant support for optimum performance cross-sectional shapes and depths.
 - a. Do not leave gaps between ends of Joint Fillers.
 - b. Do not stretch, twist, puncture or tear Joint Fillers.
 - c. Remove absorbent Joint Fillers which have become wet prior to sealant application and replace with dry material.
 - 2. Install Bond Breaker to the back or bottom of the joint cavity (between sealants and joint-fillers, compression seals or back of joints where required), as recommended by the Joint Sealant manufacturer, for each type of joint and sealant used, to prevent "third-side" adhesion of the Joint Sealant to the back of the joint. Carefully apply the Bond Breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the Bond Breaker.
- H. Installation of Joint Sealants:
 - 1. Install Joint Sealant after concrete substrate material has been cast and allowed to cure. Remove protective cap from preformed Joint Filler. Remove any excess Joint Filler material that will inhibit an adequate depth and bond of the Joint Sealant material.
 - 2. Place masking tape where required along the joint cavity to prevent contact of the Joint Sealant with adjoining surfaces. Remove masking tape within ten (10) minutes after joint has been filled and tooled.
 - 3.
 - 4. Apply the Joint Sealant in accordance with the manufacturer's printed instructions with an application tool having a nozzle that fits the width of the joint cavity. Install Joint Sealant by proven techniques to contact and solidly full wet joint substrates, completely filling the recesses provided for each joint configuration, providing uniform, optimum performance cross-sectional shapes and depths. Do not allow spillage or migration of Joint Sealant onto adjoining surfaces.
- I. Tooling of Non-Sag Joint Sealants: Tool Non-Sag Joint Sealants to form smooth, uniform beads of configuration indicated, free of wrinkles, streaks, gouges, boils, air holes, etc. and to ensure contact and adhesion of the Joint Sealant with the sides of the joint. Remove excess Joint Sealants from surfaces adjacent to joint. Do not use tooling agents which discolor Joint Sealants or adjacent surfaces or are not approved by Sealant Manufacturer.
- J. Sanding of Joint Sealant: Lightly apply dry sand to cover freshly-poured elastic Joint Sealant material. When Joint Sealant has hardened, remove excess sand that has not bonded to Joint Sealant.

K. Protection and Curing:

1. Protect installed Joint Sealants during and after curing period from contact with contaminating substances or from damage.
2. Cut out and remove damaged or deteriorated Joint Sealers and reseal joints with matching new materials.
3. Clean off excess Joint Sealants or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved by the Sealant Manufacturer.

3.11 REPAIRS AND PROTECTION

- A. Remove in its entirety (from joint to joint) and replace concrete pavement that is broken, cracked, damaged, or defective, or concrete which does not meet requirements of this Section.
- B. Drill test cores where directed by the Landscape Architect, when necessary, to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least fourteen (14) days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two (2) days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 321316 - ARCHITECTURAL AND DECORATIVE CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make a complete Decorative Concrete Paving installation, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Integral Color for concrete paving.
 - 2. Surface Retardant for concrete paving textures and finishes.
 - 3. Surface Texturing and Stamping for concrete paving finishes.
 - 4. Sandblasting for concrete paving textures and finishes.
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section:
 - 2. Section 32 13 13 "Landscape Architectural Cement Concrete Paving".
 - 3. Section 32 13 23 "Cast-in-Place Concrete for Landscape Elements".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
 - 3. ACI – American Concrete Institute.
 - 4. PCA – Portland Cement Association.
 - 5. CRSI – Concrete Reinforcing Steel Institute.
 - 6. SWRI – Sealant, Waterproofing & Restoration Institute.
 - 7. UBC – Uniform Building Code.
 - 8. NRMCA – National Ready Mix Concrete Association.
 - 9. ADAAG – American with Disabilities Act Accessibility Guidelines.
 - 10. TAS – Texas Accessibility Standards
- A. Definitions:
 - 1. Cementitious Materials: Portland Cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
 - 2. Percent Compaction: Per ASTM D1557, percentage of the maximum in-place dry density of the same material, as determined by Geotechnical Engineer.
 - 3. Low Carbon Concrete: Concrete that is designed with the intent of reducing the carbon footprint when compared to traditional concrete. The carbon footprint is reduced by the option of alternative cement types, the replacing cement content with supplementary

cementitious materials (SCMs), using recycled concrete aggregate (RCA), chemical add mixtures, performance base concrete and using alternate fuel source to that power batch plant and transportation vehicles. In this specification LCC will be measured by the GWP Cap value or cement limits as define in the concrete mix designs.

4. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
 - a. Portland Cement: Meet ASTM C150.
 - 1) Cement Type: Type I
 - 2) Cement Type: Type II/V
 - 3) Cement Type: Type III
 - b. Hydraulic Blended Cement: Meet ASTM C595
 - 1) Type 1L Portland-Limestone Cement (PLC):
 - i. PLC may contain anywhere from 5% to 15% limestone.
 - ii. Portland Limestone Cement lowers the CO2 by 8-12% per Ton of Cement
 - iii. PLC complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - 2) Type 1S Portland-Slag Cement
 - i. Complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - 3) Type 1P Portland Pozzolan Cement
 - i. Complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - 4) Type 1T Ternary Blended Cements
 - i. Complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - c. ASTM C1157 Cement Performance Types:
 - 1) Type MS: Moderate Sulfate Resistance
 - 2) Type LH: Low Heat of Hydration
 - 3) Type GU: General Use
 - 4) Type HE: High Early-Strength
 - 5) Type HS: High Sulfate Resistance
 - 6) Type MH: Moderate Heat of Hydration
 - d. Supplementary Cementitious Materials (SCM): An SCM is defined by ASTM International as “an inorganic material that contributes to the properties of a cementitious mixture through hydraulic or pozzolanic activity, or both” (2015 ASTM).
 - 1) Fly Ash: Flyash: Pozzolan admixtures, conforming to ASTM C618, Class C or Class F, with weight loss of ignition limited to not to exceed 3 percent shall be used in mix designs to replace Portland Cement. Final replacement value to be determined by the ready-mix plant and shall be coordinated with the use of PLC Type IL MS/LH, ASTM C595 Compliant.
 - 2) Ground Granulated Iron Blast-Furnace Slag: Meet ASTM C989.
 - 3) Silica Fume: Meet ASTM C1240
 - 4) Natural Pozzolans: Meet ASTM C618
 - 5) Reference: ACI 211.4R-93.

5. Recycled Concrete Aggregate (RCA): Recycled concrete aggregate (RCA) comes from the processing of concrete from either previous infrastructure projects or waste concrete left over from placements. The concrete is crushed into a material of a specified size and quality.
 6. GWP: Global Warming Potential: The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO₂). The larger the GWP, the more that a given gas warms the Earth compared to CO₂ over that time period. The time period usually used for GWPs is 100 years. GWPs provide a common unit of measure, which allows analysts to add up emissions estimates of different, and allows policymakers to compare emissions reduction opportunities across sectors and gases. (GWP as defined by the US EPA)
 7. EPD: Environmental Product Declaration: Type III environmental declarations present quantified environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function. Such declarations 1. are provided by one or more organizations, 2. are based on independently verified life cycle assessment (LCA) data, life cycle inventory analysis (LCI) data or information modules in accordance with the ISO 14040 series of standards and, where relevant, additional environmental information, 3. are developed using predetermined parameters, and 4. are subject to the administration of a program operator, such as a company or a group of companies, industrial sector or trade association, public authorities or agencies, or an independent scientific body or other organization
- B. Standards of Construction:
1. ACI 214 – Recommended Practice for Evaluation of Strength Tests Results of Concrete.
 2. ACI 301 – Details and Detailing of Concrete Reinforcement.
 3. ACI 305 – Recommended Practices for Cold Weather Concreting.
 4. ACI 306 – Recommended Practices for Hot Weather Concreting.
 5. ACI 308 – Standard Practice for Curing Concrete.
 6. ACI 347 – Recommended Practice for Concrete Formwork.
 7. ASTM A185 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 8. ASTM C33 – Specification for Concrete Aggregates.
 9. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 10. ASTM C94 – Specification for Ready-Mix Concrete.
 11. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregate.
 12. ASTM C143 – Test Method for Slump of Portland Concrete Cement.
 13. ASTM C150 – Specification for Portland Cement.
 14. ASTM C260 – Air-Entraining Admixtures for Concrete.
 15. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
 16. ASTM C494 – Chemical Admixtures for Concrete.
 17. ASTM C595- Standard Specification for Blended Hydraulic Cements
 18. ASTM A615 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 19. ASTM D1751 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).

20. National Ready Mix Concrete Association, latest revision: "Certificate of Conformance for Concrete Production Facilities".
 21. ASTM C1157 – Standard Performance Specification for Hydraulic Cement.
 22. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 23. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars
 24. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures
- C. Measurements:
1. PSI: Measurement, in pounds per square inch.
 2. SF/FT: Measurement, in square-foot.
 3. CU/YD: Measurement in cubic-yard.
 4. Kg CO2e: Measurement, in kilograms of carbon dioxide equivalent.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Product/Material Data: Submit Manufacturers' current available Product Data catalog cuts sheets, specifications, and manufacturing sources for each type of material and product indicated herein this Article (as applicable). Data shall also include source and/or Manufacturer's name, address, and telephone numbers.
1. Reinforcement and Forming Accessories, and Certificate of compliance.
 2. Joint Systems: Expansion joint filler, sealant, backer rod and bond breaker. (provide physical samples of the sealant for color selection)
 3. Curing Compound.

4. Standard Specification for Blended Hydraulic Cements: Type 1L Portland-Limestone Cement (PLC): ASTM C595 / AASHTO M240
 - a. Type 1S Portland-Slag Cement: ASTM C595 / AASHTO M240
 - b. Type 1P Portland Pozzolan Cement: ASTM C595 / AASHTO M240
 - c. Type 1T Ternary Blended Cements: ASTM C595 / AASHTO M240
5. Sealer
6. Statement of Mix Design, prepared by the batch plant servicing the Project, for each type or load delivered to Project. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Each Statement of Mix Design shall include following information:
 - a. Name, address, and telephone number of batch plant preparing Statement of Mix Design.
 - b. Date of Mix Design.
 - c. Project location.
 - d. Contractor requesting load delivery.
 - e. Mix Design Number.
 - f. Cement Type and quantity by volume
 - g. SCM - Post-industrial pozzolan (Fly ash, slag, ground limestone, natural pozzolan) cement substitution as a percentage of the full product composite by volume.
 - h. Admixtures (as required).
 - i. Integral Color Admixtures (as required).
 - j. Gradations for sand and aggregate and RCA content, indicate content by percentage by volume.
 - k. Material weights, specific gravity, and absolute volumes.
 - l. Basis of testing, i.e. UBC 2605 D4 and CBC Title 24 2604 D4.
 - m. Water/Cement Ratio.
 - n. Slump.
 - o. PSI rating.
- H. EPD Information for Concrete Mix Design (As Available per Ready Mix Plant)
 1. EPD Submittal:
 - a. Completed Environmental Product Declaration Reporting Form for each concrete mix design.
 - b. For products with completed Environmental Product Declaration Reporting Forms claiming availability of an applicable EPD, provide the Product-Specific or Industry-Wide Type III Environmental Product Declaration (EPD) in compliance with ISO 14025.
 - c. GWP Range: Per mix design
 - I. Low Carbon Concrete Compliance
 1. This submittal shall indicate the concrete compressive strengths with cement limits measured in lbs/cubic yard per mix design.
 2. Low Carbon Concrete Compliance shall be provided when EPD's are not available.
 - J. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color, pattern, or texture selection.
 - K. Samples for Verification: For each type of exposed color, pattern, or texture indicated.
 - L. Miscellaneous Submittals:

1. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- M. Qualification Data: For qualified Installer and ready-mix concrete manufacturer.
- N. Material Certificates: For the following, from manufacturer:
 1. Cementitious materials.
 2. Steel reinforcement and reinforcement accessories.
 3. Fiber reinforcement.
 4. Admixtures.
 5. Curing compounds.
 6. Applied finish materials.
 7. Bonding agent or epoxy adhesive.
 8. Joint fillers.
- O. Material Test Reports: For each of the following:
 1. Aggregates.
- P. Field quality-control reports.

1.4 QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative concrete paving systems or with experience in material application of one (1) or more years.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Source Limitations: Obtain decorative concrete paving products and each type or class of cementitious material of the same brand from same manufacturer's plant, and obtain each aggregate from single source.
- E. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- F. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.
- G. Field-Constructed Mock-up Samples:
 1. General: Prior to the installation of Work under this Section, Contractor shall erect Field-Constructed Mock-up Samples for each type and pattern of Concrete Paving required for review and approval by the Landscape Architect, to verify selections made under the referee samples obtained by the Landscape Architect.

2. Build Field-Constructed Mock-up Samples to comply with the following requirements, using materials and same base construction including special features for form work, jointing, surface finishes, textures, color(s), and contiguous Work as indicated for the final unit of Work.
 - a. Locate Field-Constructed Mock-up Samples on the Project Site in location(s) as directed by the Owner.
 - b. Notify the Landscape Architect, in writing, at least five (5) days in advance of the dates and times when Field-Constructed Mock-up Samples will be erected.
 - c. Demonstrate quality and range of aesthetic effects and workmanship in the Field-Constructed Mock-up Samples that will be produced in final unit of Work.
 - d. Obtain the Landscape Architect's acceptance of Field-Constructed Mock-up Samples, in writing, before start of installation of Work.
 - e. Retain and maintain Field-Constructed Mock-up Samples during construction in an undisturbed condition as a standard for judging the completed unit of Work.
 - f. When directed by the Owner, Contractor shall demolish and remove Field-Constructed Mock-up Samples from Project Site.
 3. Size: Each Field-Constructed Mock-up Sample within this Section shall measure a minimum of three-feet (3'-0") wide x six-feet (6'-0") long to compare the aesthetics of material colors, textures, and finishes.
 4. When the Landscape Architect determines that a Field-Constructed Mock-up Sample does not meet acceptable requirements, retain it for reference and cast another Field-Constructed Mock-up Sample (as required) until the Sample is accepted.
 5. Accepted Field-Constructed Mock-up Samples will be the standard by which Work under this Section will be evaluated for technical and aesthetic merit. Accepted Field-Constructed Mock-up Samples are the prerequisite to the commencement of Work.
- H. Pre-installation Conference: Conduct conference at project site.
1. Review methods and procedures related to decorative concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and decorative concrete paving construction practices.
 2. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Decorative concrete paving Installer.
 - d. Manufacturer's representative of decorative concrete paving system.

1.5 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves of a radius of 100 feet or less. Do not use notched and bent forms.
- B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.
- D. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.
- E. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.
- F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

- A. Hydraulic Blended Cement: Meet ASTM C595. Use one (1) brand of cement (single source) throughout the Project, unless otherwise acceptable to the Landscape Architect. Contractor shall verify the cement color with the Landscape Architect. Cement Types as follow:
 - 1. Cement Type: Type IL Portland-Limestone Cement
 - 2. Cement Type: Type IS Portland-Slag Cement
 - 3. Cement Type: Type IP Portland-Pozzolan Cement: Portland-pozzolan cement with moderate sulfate resistance properties
 - 4. Cement Type: Type IT Ternary Blended Cement
- B. ASTM C1157 Cement Performance Types:
 - 1. Type MS: Moderate Sulfate Resistance
 - 2. Type LH: Low Heat of Hydration
 - 3. Type GU: General Use

4. Type HE: High Early-Strength
 5. Type HS: High Sulfate Resistance
 6. Type MH: Moderate Heat of Hydration
- C. Portland Cement: Meet ASTM C150. Use one (1) brand of cement (single source) throughout the Project, unless otherwise acceptable to the Landscape Architect. Contractor shall verify the cement color with the Landscape Architect. Cement Type as follows:
1. Cement Type: Type I.
 2. Cement Type: Type II/V.
 3. Cement Type: Type III.
- D. Aggregate: ASTM C 33, uniformly graded, from a single source, gray in color only, with coarse aggregate as follows:
1. Class: 4M.
 2. Maximum Aggregate Size: 3/4 inch nominal.
 3. Do not use fine or coarse aggregates containing substances that cause spalling.
- E. Normal-Weight Recycled Concrete Aggregates (RCAs): Meet ASTM C33, Class 1N, and as follows:
1. Fine Aggregates: Meet ASTM C33, clean, hard, non-reactive, and durable sand. Do use sand coated with injurious amounts of silt, loam, clay or other deleterious matter.
 2. Grading Requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100%
No. 4	95-100%
No. 8	80-100%
No. 16	50-85%
No. 30	25-60%
No. 50	5-30%
No. 100	0-10%

3. Coarse Recycled Concrete Aggregates: Meet ASTM C33, hard, durable, non-reactive, uncoated, graded, cleaned, and screened crushed rock or gravel aggregate for regular weight concrete. Do not use crusher-run stone or bank-run gravel. Aggregate shall be from a single source and shall be like in visual appearance.
 - a. Grading: Do not use Coarse Aggregate which has a maximum size exceeding 1/5 of the narrowest dimension between sides of forms of the member for which concrete is to be used, nor larger than ¾ of the minimum clear spacing between reinforcing bars.
 - 1) Do not use coarse Aggregate for pavements which exceeds ¾ inch diameter.

- 2) Do not use coarse aggregates that contain substances that cause spalling.
4. Fine Recycled Concrete Aggregate:
 - a. Description: ASTM C33, clean, hard and durable sand. Do not use sand coated with injurious amounts of silt, loam, clay or other deleterious matter.
 - b. Grading Requirements:

<u>Percent Passing</u>	<u>Sieve Size</u>
45-70	# 16
15-30	# 50
3- 8	#100
 - c. Local aggregates not complying with ASTM C33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to the Landscape Architect.
- F. Supplementary Cementitious Materials (SCM):
 1. Fly Ash: Flyash: Pozzolanic admixtures, conforming to ASTM C618, Class C or Class F, with weight loss of ignition limited to not to exceed 3 percent shall be used in mix designs to replace Portland Cement. Final replacement value to be determined by the ready-mix plant and shall be coordinated with the use of PLC Type IL MS/LH, ASTM C595 Compliant.
 2. Ground Granulated Iron Blast-Furnace Slag: Meet ASTM C989.
 3. Silica Fume: Meet ASTM C1240
 4. Natural Pozzolans: Meet ASTM C618
 5. Reference: ACI 211.4R-93.
- G. Water: Per ASTM C1602, from potable domestic source, free from deleterious materials such as oils, acids, and organic matter.
- H. Air-Entraining Admixture: ASTM C 260.
- I. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A [colored].
- J. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Davis Colors.
 - b. Dayton Superior Corporation.
 - c. Scofield, L. M. Company.
 - d. Solomon Colors, Inc.
 - e. Specialty Concrete Products, Inc.
 - f. SureCrete Design Products.
 - g. Or other, as approved by Landscape Architect.

2.4 FIBER REINFORCEMENT

- A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Monofilament Fibers:
 - 1) Grace, W. R. & Co. - Conn.; Grace MicroFiber.
 - 2) Or other, as approved by Landscape Architect.

2.5 SURFACE RETARDENT

- A. Water Based, Top Surface Retardant: Water Based, top surface applied retarder providing various depths of etch to surface to produce permanent aggregate exposure or surface texturing.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. W.R Grace & Co.: Top Cast Surface Retarder
 - b. Or other, as approved by Landscape Architect.
- B. Refer to document Finish schedule for level of finish required and coordinate with product code and color of matching finishes.

2.6 INTEGRAL COLOR

- A. Product: The color together with color conditioning admixtures shall be a single – component, colored, water – reducing, set controlling admixture, factory formulated and packaged in cubic yard dosage increments, not multiple additives and pigments added separately into the mix. It shall comply with ASTM C 494 and ASTM C979.
 - 1. Refer to finish schedule on drawings for manufacturer.
 - 2. If other manufacturers pigment colors are used, concrete contractor shall provide mix design with water reducing and setting agents to comply with ASTM C494 and ASTM C979.
- B. Do not place disintegrating bags in the hopper, carefully pour the contents of the bag at the approved rate and scrape any excess into the concrete mixer, discard the bags. Wear recommended safety equipment during color addition and avoid pigment and color agent dust.
 - 1. Color: As indicated on the drawings. Match approved sample.

2.7 SURFACE COLORING MATERIALS

- A. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; A-H S-Q Hardener.
 - b. Artcrete, Inc.; Faux Brick Color Hardener.
 - c. BASF Construction Chemicals, LLC; Mastercron.

- d. Bomanite Corporation; Color Hardener.
 - e. Butterfield Color; Perma-Cast Shake-on Color Hardener.
 - f. ChemMasters; ConColor.
 - g. Conspec by Dayton Superior; Conshake 600 Colortone.
 - h. Dayton Superior Corporation; Quartz Tuff.
 - i. Decosup Inc.; HardBright Color Hardener.
 - j. Dynamic Color Solutions, Inc.; Dynamicast Color Hardener.
 - k. Euclid Chemical Company (The), an RPM company; Surfplex.
 - l. Lambert Corporation; COLORHARD.
 - m. L&M Construction Chemicals, Inc.; QUARTZPLATE FF.
 - n. QC Construction Products; QC Color Hardener.
 - o. Scofield, L. M. Company; LITHOCHROME Color Hardener.
 - p. Southern Color N.A., Inc.; Mosaics Color Hardener.
 - q. Specialty Concrete Products, Inc.; CHROME-HARD Color Hardener.
 - r. SuperStone, Inc.; Color Hardener.
 - s. SureCrete Design Products; Color Hardener.
 - t. Symons by Dayton Superior; Hard Top.
- B. Pigmented Powder Release Agent: Factory-packaged, dry combination of surface-conditioning and dispersing agents interground with color pigments that facilitates release of stamp mats. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Surfaces Inc.; Release Agent.
 - b. Bomanite Corporation; Release Agent.
 - c. Bon Tool Co.; True Color Release Agent.
 - d. Brickform; Antique Release.
 - e. Butterfield Color; Perma-Cast Antiquing Release.
 - f. Decosup Inc.; Decosup Release Powder.
 - g. Dynamic Color Solutions, Inc.; Dynamicast Color Release Agent.
 - h. Scofield, L. M. Company; LITHOCHROME Antiquing Release.
 - i. Southern Color N.A., Inc.; Mosaics Antique Release.
 - j. Specialty Concrete Products, Inc.; SCP Powder Release Agent.
 - k. Stampcrete International Ltd.; Colored Release Agent.
 - l. SuperStone, Inc.; Pigmented Release Powder.
 - m. SureCrete Design Products; Powder Release.
- C. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation that facilitates release of stamp mats and texture rollers.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Surfaces Inc.; Liquid Release.
 - b. Artcrete, Inc.; Faux Brick Release Agent - Liquid.
 - c. Bon Tool Co.; Liquiform Release Agent.
 - d. Brickform; Liquid Release.
 - e. Butterfield Color; Butterfield Color Clear Liquid Release.

- f. Decosup Inc.; Decosup Liquid Release.
- g. Matcrete Precision Stamped Concrete Tools; Liquid Release Agent.
- h. Proline Concrete Tools, Inc.; Dura-Liquid Release Agent.
- i. Scofield, L. M. Company; LITHOTEX Liquid Release.
- j. Southern Color N.A., Inc.; Mosaics Clear Liquid Release.
- k. Stampcrete International Ltd.; Stampcrete Liquid Release.
- l. Superior Decorative by Dayton Superior; Pro Liquid Release.
- m. SuperStone, Inc.; Bubble Gum Liquid Release.
- n. Symons by Dayton Superior; Clear Liquid Release.

2.8 STAMPING DEVICES

- A. Stamp Mats: Semirigid polyurethane mats with projecting textured and ridged underside capable of imprinting texture and joint patterns on plastic concrete.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Surfaces Inc.
 - b. Bomanite Corporation.
 - c. Bon Tool Co.
 - d. Brickform.
 - e. Butterfield Color.
 - f. Creative Urethane Concepts, Inc.
 - g. Matcrete Precision Stamped Concrete Tools.
 - h. Proline Concrete Tools, Inc.
 - i. Scofield, L. M. Company.
 - j. Southern Color N.A., Inc.
 - k. Stampcrete International Ltd.
 - l. Superior Decorative by Dayton Superior.
 - m. SuperStone, Inc.
 - n. SureCrete Design Products.
- B. Stamp Tools: Open-grid, aluminum or rigid-plastic stamp tool capable of imprinting joint patterns on plastic concrete.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Matcrete Precision Stamped Concrete Tools.
 - b. Scofield, L. M. Company.
 - c. SuperStone, Inc.
- C. Rollers: Manually controlled, water-filled aluminum rollers with projecting ridges on drum capable of imprinting texture and joint patterns on plastic concrete.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bon Tool Co.
 - b. Brickform.
 - c. <Insert manufacturer's name>.

2.9 STAIN MATERIALS

- A. Reactive Stain: Acidic-based stain with wetting agents and high-grade, UV-stable metallic salts that react with calcium hydroxide in cured concrete to produce permanent, variegated, or translucent color effects.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Americrete, Inc.; A-8000 Reactive Stains.
 - b. Artcrete, Inc.; Faux Brick Concrete Stain.
 - c. Bomanite Corporation; Chemical Stain.
 - d. Bon Tool Co.; True Etch Acid Stain.
 - e. Brickform; Blush-Tone Acid Stain.
 - f. Butterfield Color; Perma-Cast Sierra Stain.
 - g. Decosup Inc.; ChemTone Masonry Reactive Stain.
 - h. H&C Concrete Care Products; Infusion Reactive Concrete Stain.
 - i. Kemiko; Kemiko Stone Tone Stain.
 - j. QC Construction Products; QC Patina Stain.
 - k. Scofield, L. M. Company; Lithochrome Chemstain Classic.
 - l. Southern Color N.A., Inc.; Mosaics Reactive Stain.
 - m. Specialty Concrete Products, Inc.; CHROME-ETCH Acid Stain.
 - n. Stampcrete International Ltd.; Patina Stain.
 - o. SuperStone, Inc.; ChlorStain.
 - p. SureCrete Design Products; SureStain.
- B. Penetrating Stain: Water-based, acrylic latex, penetrating stain with colorfast pigments.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Americrete, Inc.; A-1000 Concrete Stain.
 - b. Bomanite Corporation; Con-Color.
 - c. Bon Tool Co.; Water Based Concrete Stain.
 - d. Brickform; Freestyle Solid-Color Stain.
 - e. Butterfield Color; Water Based Concrete Stain.
 - f. Duckback Products; DB6000 Mason's Select Transparent Concrete Stain.
 - g. H&C Concrete Care Products; Shield Plus Ultra Concrete Stain.
 - h. Scofield, L. M. Company; Lithochrome Tintura Stain.
 - i. SuperStone, Inc.; Hydro-Tone.
 - j. Symons by Dayton Superior; Patina Stain.

2.10 SEEDED AGGREGATE SURFACING

- A. Aggregate for Exposed Aggregate Concrete Surface Finish:
 - 1. Refer to finish schedule on drawings for stone/gravel specifications including color, size and sourcing.

2.11 CHEMICAL ADMIXTURES FOR CONCRETE

- A. General: Admixtures shall be certified by the Manufacturer to contain no more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other

Admixtures. Use of Admixtures shall not relieve the Contractor of the designated concrete requirements, including strength.

- B. Air-Entraining Admixture: Meet ASTM C260.
- C. Water-Reducing Admixture: Meet ASTM C494, Type A.
- D. Water-Reducing and Set Retarding Admixture: Meet ASTM C494, Type B and D.
- E. Shrinkage-Reducing Admixture: Meet ASTM C157. Provide at dosage of 2% by weight of cement.
- F. Integral Concrete Coloring Admixture: Provide materials specifically designed for use in ready-mix concrete, from a single source, and shall be like in color and visual appearance. Meet ASTM C979.

2.12 RELATED MATERIALS

- A. Expansion Joint Materials:
 - 1. Expansion Joint:
 - a. W.R. Meadows or equal, Ceramar flexible foam expansion joint 1/4 inch
 - b. Metal keyway with 1/4 inch pull strip and foam expansion material.

2.13 CURING AND SEALING MATERIALS

- A. Curing Paper: Nonstaining, waterproof paper, consisting of two layers of kraft paper cemented together and reinforced with fiber, and complying with ASTM C 171.
- B. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals, LLC; Confilm.
 - b. Brickform; Evaporation Retarder.
 - c. Conspec by Dayton Superior; Aquafilm.
 - d. Dayton Superior Corporation; Sure Film (J-74).
 - e. Kaufman Products, Inc.; VaporAid.
 - f. Meadows, W. R., Inc.; EVAPRE.
 - g. Sika Corporation, Inc.; SikaFilm.
 - h. SpecChem, LLC; Spec Film.
 - i. Symons by Dayton Superior; Finishing Aid.
 - j. Or other as approved by landscape architect.
- C. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B, manufactured for colored concrete.
 - 1. For integrally colored concrete, curing compound shall be pigmented type approved by coloring admixture manufacturer.
 - 2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.
- D. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type I, Class A, manufactured for use with colored concrete.

- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type I, Class A, manufactured for use with colored concrete.
- F. Clear Acrylic Sealer: Manufacturer's standard, waterborne, non-yellowing and UV-resistant, membrane-forming, medium-gloss, acrylic copolymer emulsion solution, manufactured for colored concrete, containing not less than 15 percent solids by volume.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Bomanite Corporation; Bomanite Hydrocoat.
 - b. Brickform; Satin-Seal.
 - c. Scofield, L. M. Company; CEMENTONE Clear Sealer.
 - d. Or others as approved by landscape architect.

2.14 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1752, cork or self-expanding cork in preformed strips.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types I and II, non-load bearing for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Polyethylene Film: ASTM D 4397, 1 mil (0.025 mm) thick, clear.

2.15 CONCRETE MIXES AND PROPORTIONING

- A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength for each type of normal-weight concrete in accordance with current edition of ACI's "Manual of Concrete Practice" and the PCA's "Design and Control of Concrete Mixtures".
 - 1. Use transit mixer trucks equipped with automatic devices for recording number of revolution of drum.
- B. Slump: Adjust quantity of water so concrete at point and time of discharge does not exceed the aforementioned slumps when tested per ASTM C143. Use the minimum water necessary for workability required by part of item being cast.
- C. Proportion Concrete Mixes to provide Low Carbon Concrete with the following properties:
 - 1. Vehicular Paving Use Areas:
 - a. Compressive Strength (28 Days): Minimum 4,000 PSI.
 - b. GWP Cap: 300 kg CO₂e /m³ (as verified by concrete submittal) , and/or
 - c. Cement Limit (lbs/cubic yard): 456
 - d. Maximum Water-Cementitious Materials Ratio: 0.45.
 - e. Slump Limit: 4 inches.
 - 2. Pedestrian Paving Use Areas and Stairs:
 - a. Compressive Strength (28 Days): Minimum 3,000 PSI.
 - b. GWP Cap: 275 kg CO₂e /m³ (as verified by concrete submittal) , and/or

- c. Cement Limit (lbs/cubic yard): 410
 - d. Maximum Water-Cementitious Materials Ratio: 0.45.
 - e. Slump Limit: 5 inches.
- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials (other than Portland Cement) in concrete as follows"
 - 1. Supplemental Cementitious Material (SCM) for Low Carbon Concrete (LCC): Final type and weight of cementitious replacement materials to be provided by the Ready-Mix Plant. SCMs used shall help to meet the GWP cap as noted in the mix design requirements.
 - a. GGBFS: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - b. Pozzolans: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - 1) Fly Ash: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - 2) Natural Pozzolan: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - 3) Silica Fume: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
- E. Add Air-Entraining Admixture at the Manufacturer's prescribed rate to result in concrete at point of placement. If used, do not exceed two-percent (2%).
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 1.5 percent:
 - 1. Air Content: 5.5 percent for 1-1/2-inch maximum aggregate.
 - 2. Air Content: 6.0 percent for 1-inch and 3/4-inch maximum aggregate.
- G. Shrinkage Reducing Admixture at 1 gallon used per cubic yard of concrete to reduce cracking.
- H. Coloring Agent: Add coloring agent to mix according to Manufacturer's written instructions. See drawings for color and manufacture information.
- I. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.
- J. Concrete Delivery: Use of concrete loads exceeding ninety (90) minutes from time of batch plant must be approved by the Landscape Architect
- K. Ensure that the batch plant guarantees a single-source supply for Cement, Sand, and Aggregate for the entire project.
- L. CONCRETE MIXING
- M. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

3.2 EXAMINATION

- A. Examine exposed sub-grades and sub-base surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared sub-base surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll sub-base in one direction. Limit vehicle speed to 3 mph (5 km/h).
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct sub-base with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 31 22 13 "Rough Grading."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Remove loose material from compacted sub-base surface immediately before placing concrete.
- B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.4 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

- D. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

3.6 JOINTS

- A. General: Form construction, expansion, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. Dowelled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 60 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch where indicated or approved radius. Repeat tooling of edges after applying surface finishes. Eliminate edging tool marks on concrete surfaces.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from sub-base surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten sub-base to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

- K. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and sub-grade just before placing concrete. Keep sub-grade moisture uniform without standing water, soft spots, or dry areas.

3.8 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

3.9 SURFACE RETARDER APPLICATION

- A. Protect adjacent surfaces, vertical and horizontal, from receipt of application.
- B. Prepare product, shaking application to thoroughly mix product contents prior to application per manufacturer.
- C. Apply product evenly, equally and consistently at rate per manufacturer using sprayer applicator clean and rinsed of previous products.
- D. Allow product to dry at rate per manufacturer, cover as required from adverse weather conditions until time as noted by manufacturer as protected.
- E. Remove product upon proper cure time as described by manufacturer to reach approved, through mock-up, sample to meet texture.
- F. Refer to manufacturer for further information on product cure time, rate and removal procedures.

3.10 AGGREGATE SURFACING APPLICATION

- A. Seeded Exposed Aggregate Finish:
1. Seeding: Immediately after the slab has been screeded and darbied, evenly distribute aggregates over the surface with minimum gaps in between.
 2. Embedding: Hand-float the surface and then steel-trowel so that all aggregates are entirely and evenly embedded just beneath the surface.
 3. Retarding: Spray on surface retardant evenly over surfaces to be exposed. Protect adjacent fresh concrete surfaces, bands, etc., that are not to be exposed.

4. Depth: At the elapsed time specified by the retardant manufacturer, simultaneously flood and brush to obtain a clean, uniform surface with no aggregate exposed more than 1/8".
5. Exposing of Aggregates: Do not dislodge or unevenly expose the aggregates. Avoid direct hosing of the surface and do not use a pressurized nozzle.

3.11 STANDARD SURFACE CONCRETE FINISHES

A. General:

1. Finished pavement surfaces indicated herein this Section shall be "slip-resistant", per the requirements outlined in and per ADAAG 4.5.1.
 - a. The minimum coefficient of friction shall meet or exceed 0.8 on exterior and 0.6 on interior surfaces.
 - b. Pavement surfaces shall have the following finish on all surfaces less than six percent (6%) slope:
 - 1) Medium Broom Textured Finish, or a textured finish as specified which is equivalent to the finished texture of a Medium Broom Textured Finish.
 - c. Pavement surfaces shall have the following finish on all surfaces greater than six percent (6%) slope:
 - 1) Heavy Broom Textured Finish, or a textured finish as specified which is equivalent to the finished texture of a Heavy Broom Textured Finish.
 - d. Color(s) and finish(es) specified herein shall match referee samples and field-constructed mock-up samples as approved by the Landscape Architect.
 - e. Wetting of concrete surfaces during screeding, initial floating, or finishing operations is strictly prohibited.

B. Acid-Etch Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.

1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
2. Float-finish the concrete surface to provide a uniform, consistent texture.
3. Provide contraction jointing and edging, as required, in the locations indicated in the Contract Drawings, and of the type(s) indicated herein this Section. Early-entry jointing of concrete may be required to prevent premature cracking of finished surfaces. Do not use curing compounds.
4. Approximately one (1) to two (2) days after the concrete has been cast, evenly spray-apply a muriatic acid wash (a diluted solution of approximately a 10:1 ratio of water to acid) or a top-cast solution to the concrete surface. Prevailing weather conditions will affect timing and strength of the acid-wash solution, and in cold and rainy conditions, more time may be needed for the concrete to start the hydration process before the acid-wash solution can be applied.
5. Handle acid and acid wash solution with care to avoid spillage and staining. Protect areas adjacent to the Work from over-spray of the acid solution. Provide neutralizing solution(s) to the acid solution, as needed, to prevent chemicals from damaging or contaminating adjoining planting areas.

6. After acid has adequately etched the concrete surface, gently flush the surface with fresh water to remove the acid solution. Do not use high pressure washer to apply water or to remove the acid solution from the surface.
 7. After concrete is fully hydrated (approx. 30-days), seal acid etched concrete finished surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
 - a. Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for Sealer requirements.
- C. Sandblast Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.
1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
 2. Work shall conform to CAL OSHA /MSDS for application and clean up procedures.
 3. After concrete is fully hydrated (approx. 30-days), provide a sandblast-textured finish to the exposed concrete surfaces, revealing the desired aggregates, with the following surface texture:
 - a. Light Sandblast Texture.
 - b. Medium Sandblast Texture:
 - c. Heavy Sandblast Texture.
 4. Provide jointing in the locations indicated in the Contract Drawings.
 5. Seal sandblast texture finished concrete surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
 - a. Refer to the Cast-in-Place Concrete Paving Schedule for Sealer requirements.

3.12 PIGMENTED MINERAL DRY-SHAKE HARDENER

- A. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake hardener at a rate of 100 lb./100 sq. ft. unless greater amount is recommended by manufacturer to match paving color required.
 2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
 3. After final power floating, apply the following finish:
 - a. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - b. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
 - c. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

4. Pigmented Powder Release Agent: Uniformly distribute onto dry-shake-hardened and still-plastic concrete at a rate of 3 to 4 lb./100 sq. ft. (1.5 to 2 kg/10 sq. m).
5. Liquid Release Agent: Uniformly mist surface of dry-shake-hardened and still-plastic concrete at a rate of 5 gal/1000 sq. ft. (0.2 L/sq. m).

3.13 STAMPING

- A. Mat Stamping: After floating and while concrete is plastic, apply mat-stamped finish.
 1. Pigmented Powder Release Agent: Uniformly distribute onto concrete at a rate of 3 to 4 lb./100 sq. ft. (1.5 to 2 kg/10 sq. m).
 2. Liquid Release Agent: Apply liquid release agent to the concrete surface and the stamp mat. Uniformly mist surface of concrete at a rate of 5 gal/1000 sq. ft. (0.2 L/sq. m).
 3. After application of release agent, accurately align and place stamp mats in sequence.
 4. Uniformly load mats and press into concrete to produce required imprint pattern and depth of imprint on concrete surface. Gently remove stamp mats. Hand stamp edges and surfaces unable to be imprinted by stamp mats.
 5. Revise minimum time period in subparagraph below if required. The recommended time period to wait before removing residual release agent varies from 2 to 10 days among manufacturers. Concrete must be strong enough to not be damaged.
 6. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.
- B. Tool Stamping: After floating and while concrete is plastic, apply tool-stamped finish.
 1. Cover surface with polyethylene film, stretch taut to remove wrinkles, lap sides and ends 3 inches (75 mm), and secure to edge forms. Lightly broom surface to remove air bubbles.
 2. Accurately align and place stamp tools in sequence and tamp into concrete to produce required imprint pattern and depth of imprint on concrete surface. Gently remove stamp tools. Hand stamp edges and surfaces unable to be imprinted by stamp tools.
 3. Carefully remove polyethylene film immediately after tool stamping.
- C. Roller Stamping: After floating and while concrete is plastic, apply roller-stamped finish.
 1. Cover surface with polyethylene film, stretch taut to remove wrinkles, lap sides and ends 3 inches (75 mm), and secure to edge forms. Lightly broom surface to remove air bubbles.
 2. Accurately align roller and perform rolling operation to produce required imprint pattern and depth of imprint on concrete surface. Hand stamp surfaces inaccessible to roller.
 3. Carefully remove polyethylene film immediately after roller stamping.

3.14 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.

- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Compound: Apply curing compound immediately after final finishing. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after application. Maintain continuity of coating, and repair damage during curing period.
 - 1. Cure integrally colored concrete with a pigmented curing compound.
- F. Curing and Sealing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
- G. Curing Paper: Cure with unwrinkled curing paper in pieces large enough to cover the entire width and edges of slab. Do not lap sheets. Fold curing paper down over paving edges and secure with continuous banks of earth to prevent displacement or billowing due to wind. Immediately repair holes or tears in paper.

3.15 STAINING

- A. Concrete must cure prior to application of stain. Some stain colors require longer concrete curing time to meet water-vapor transmission limitations; some colors should not be used for exterior applications. Verify, with stain manufacturer, the minimum age of concrete for colors required and insert in first paragraph below. See Evaluations.
- B. Newly placed concrete paving shall be at least 14 days old before staining.
- C. Prepare surfaces according to manufacturer's written instructions and as follows:
 - 1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
 - a. Do not use acidic solutions to clean surfaces.
 - 2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by acid etching, grinding, sanding, or abrasive blasting. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
 - 3. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid-resistant nylon-bristle brushes until bubbling stops and concrete surface has texture of 120-grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
 - 4. Waterborne stains are pH sensitive. Revise pH value or test method in subparagraph below to suit Project.

5. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface according to ASTM F 710 to ensure pH is between 7 and 8.
- D. Scoring: Score decorative jointing in paving surfaces 1/16 inch (1.6 mm) deep with diamond blades to match pattern indicated. Rinse until water is clear. Score before staining.
 1. Joint Width: 3/16 inch.
- E. Allow paving surface to dry before applying stain. Verify readiness of paving to receive stain according to ASTM D 4263 by tightly taping 18-by-18-inch (450-by-450-mm), 4-mil- (0.1-mm-) thick polyethylene sheet to a representative area of paving surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.
- F. Reactive Stain: Apply reactive stain to paving surfaces according to manufacturer's written instructions and as follows:
 1. Apply stain by uncolored bristle brush, roller, or high-volume, low-pressure sprayer and immediately scrub into concrete surface with uncolored, acid-resistant nylon-bristle brushes in continuous, circular motion. Do not spread stain after fizzing stops. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
 2. Remove stain residue after four hours by wet scrubbing with commercial-grade detergent recommended by stain manufacturer. Rinse until water is clear. Control, collect, and legally dispose of runoff.
- G. Penetrating Stain: Apply penetrating stain to paving surfaces according to manufacturer's written instructions and as follows:
 1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
 2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
 3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

3.16 SEALER

- A. Clear Acrylic Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat using same application methods and rates.
 1. Begin sealing dry surface no sooner than 14 days after concrete placement.
 2. Allow stained concrete surfaces to dry before applying sealer.
 3. Thoroughly mix slip-resistance-enhancing additive into sealer before applying sealer according to manufacturer's written instructions. Stir sealer occasionally during application to maintain even distribution of additive.

3.17 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 1. Elevation: 1/4 inch.
 2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch.
 3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/2 inch.
 4. Lateral Alignment and Spacing of Dowels: 1 inch.

5. Vertical Alignment of Dowels: 1/4 inch.
6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
7. Joint Spacing: 3 inches.
8. Contraction Joint Depth: Plus 1/4 inch, no minus.
9. Joint Width: Plus 1/8 inch, no minus.

3.18 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 100-cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Decorative concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.19 REPAIRS AND PROTECTION

- A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.
- B. Detailing: Grind concrete "squeeze" left from tool placement. Color ground areas with slurry of color hardener mixed with water and bonding agent. Remove excess release agent with high-velocity blower.
- C. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 321323 - CAST-IN-PLACE CONCRETE FOR LANDSCAPE ELEMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Reinforced Cast-in-Place Site Concrete installations, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Cast-in-Place Site Concrete for miscellaneous footings or sub-grade foundations
 - 2. Cast-in-Place Site Concrete for sub-surface slabs
 - 3. Jointing (Expansion Joints, Contraction Joints, Isolation Joints, Keyway/Construction Joints and/or Architectural Score Joints).
 - 4. Steel Reinforcement
 - 5. Steel Dowels and Sleeves
 - 6. Compacted Sub-Surface Materials
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Division 26 - Electrical
 - 3. Section 31 22 19 "Landscape and Fine Grading".
 - 4. Section 32 13 13 "Landscape Architectural Cement Concrete Paving".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
 - 3. ACI – American Concrete Institute.
 - 4. PCA – Portland Cement Association.
 - 5. CRSI – Concrete Reinforcing Steel Institute.
 - 6. SWRI – Sealant, Waterproofing & Restoration Institute.
 - 7. UBC – Uniform Building Code.
 - 8. NRMCA – National Ready Mix Concrete Association.
- B. Definitions:
 - 1. Cementitious Materials: Portland Cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
 - 2. Percent Compaction: Per ASTM D1557, percentage of the maximum in-place dry density of the same material, as determined by Geotechnical Engineer.

3. Low Carbon Concrete: Concrete that is designed with the intent of reducing the carbon footprint when compared to traditional concrete. The carbon footprint is reduced by the option of alternative cement types, the replacing cement content with supplementary cementitious materials (SCMs), using recycled concrete aggregate (RCA), chemical admixtures, performance base concrete and using alternate fuel source to that power batch plant and transportation vehicles. In this specification LCC will be measured by the GWP Cap value or cement limits as define in the concrete mix designs.
4. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
 - a. Portland Cement: Meet ASTM C150.
 - 1) Cement Type: Type I
 - 2) Cement Type: Type II/V
 - 3) Cement Type: Type III
 - b. Hydraulic Blended Cement: Meet ASTM C595
 - 1) Type 1L Portland-Limestone Cement (PLC):
 - i. PLC may contain anywhere from 5% to 15% limestone.
 - ii. Portland Limestone Cement lowers the CO2 by 8-12% per Ton of Cement
 - iii. PLC complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - 2) Type 1S Portland-Slag Cement
 - i. Complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - 3) Type 1P Portland Pozzolan Cement
 - i. Complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - 4) Type 1T Ternary Blended Cements
 - i. Complies with ASTM C595 / AASHTO M240, Standard Specification for Blended Hydraulic Cements
 - c. ASTM C1157 Cement Performance Types:
 - 1) Type MS: Moderate Sulfate Resistance
 - 2) Type LH: Low Heat of Hydration
 - 3) Type GU: General Use
 - 4) Type HE: High Early-Strength
 - 5) Type HS: High Sulfate Resistance
 - 6) Type MH: Moderate Heat of Hydration
 - d. Supplementary Cementitious Materials (SCM): An SCM is defined by ASTM International as “an inorganic material that contributes to the properties of a cementitious mixture through hydraulic or pozzolanic activity, or both” (2015 ASTM).
 - 1) Fly Ash: Flyash: Pozzolan admixtures, conforming to ASTM C618, Class C or Class F, with weight loss of ignition limited to not to exceed 3 percent shall be used in mix designs to replace Portland Cement. Final replacement value to be determined by the ready-mix plant and shall be coordinated with the use of PLC Type IL MS/LH, ASTM C595 Compliant.
 - 2) Ground Granulated Iron Blast-Furnace Slag: Meet ASTM C989.

- 3) Silica Fume: Meet ASTM C1240
 - 4) Natural Pozzolans: Meet ASTM C618
 - 5) Reference: ACI 211.4R-93.
 5. Recycled Concrete Aggregate (RCA): Recycled concrete aggregate (RCA) comes from the processing of concrete from either previous infrastructure projects or waste concrete left over from placements. The concrete is crushed into a material of a specified size and quality.
 6. GWP: Global Warming Potential: The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO₂). The larger the GWP, the more that a given gas warms the Earth compared to CO₂ over that time period. The time period usually used for GWPs is 100 years. GWPs provide a common unit of measure, which allows analysts to add up emissions estimates of different, and allows policymakers to compare emissions reduction opportunities across sectors and gases. (GWP as defined by the US EPA)
 7. EPD: Environmental Product Declaration: Type III environmental declarations present quantified environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function. Such declarations 1. are provided by one or more organizations, 2. are based on independently verified life cycle assessment (LCA) data, life cycle inventory analysis (LCI) data or information modules in accordance with the ISO 14040 series of standards and, where relevant, additional environmental information, 3. are developed using predetermined parameters, and 4. are subject to the administration of a program operator, such as a company or a group of companies, industrial sector or trade association, public authorities or agencies, or an independent scientific body or other organization
- C. Standards of Construction:
1. ACI 214 – Recommended Practice for Evaluation of Strength Tests Results of Concrete.
 2. ACI 301 – Details and Detailing of Concrete Reinforcement.
 3. ACI 305 – Recommended Practices for Cold Weather Concreting.
 4. ACI 306 – Recommended Practices for Hot Weather Concreting.
 5. ACI 308 – Standard Practice for Curing Concrete.
 6. ACI 347 – Recommended Practice for Concrete Formwork.
 7. ASTM A185 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 8. ASTM C33 – Specification for Concrete Aggregates.
 9. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 10. ASTM C94 – Specification for Ready-Mix Concrete.
 11. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregate.
 12. ASTM C143 – Test Method for Slump of Portland Concrete Cement.
 13. ASTM C150 – Specification for Portland Cement.
 14. ASTM C260 – Air-Entraining Admixtures for Concrete.
 15. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
 16. ASTM C494 – Chemical Admixtures for Concrete.
 17. ASTM C595- Standard Specification for Blended Hydraulic Cements

18. ASTM A615 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
19. ASTM D1751 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).
20. National Ready Mix Concrete Association, latest revision: “Certificate of Conformance for Concrete Production Facilities”.
21. ASTM C1157 – Standard Performance Specification for Hydraulic Cement.
22. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
23. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars
24. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures

D. Measurements:

1. PSI: Measurement, in pounds per square inch.
2. SF/FT: Measurement, in square-foot.
3. CU/YD: Measurement in cubic-yard.
4. Kg CO2e: Measurement, in kilograms of carbon dioxide equivalent.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- A. Product/Material Data: Submit Manufacturers' current available Product Data catalog cuts sheets, specifications, and manufacturing sources for each type of material and product indicated herein this Article (as applicable). Data shall also include source and/or Manufacturer's name, address, and telephone numbers.
 1. Reinforcement and Forming Accessories, and Certificate of compliance.

2. Joint Systems: Expansion joint filler, sealant, backer rod and bond breaker. (provide physical samples of the sealant for color selection)
 3. Curing Compound.
 4. Standard Specification for Blended Hydraulic Cements: Type 1L Portland-Limestone Cement (PLC): ASTM C595 / AASHTO M240
 - a. Type 1S Portland-Slag Cement: ASTM C595 / AASHTO M240
 - b. Type 1P Portland Pozzolan Cement: ASTM C595 / AASHTO M240
 - c. Type 1T Ternary Blended Cements: ASTM C595 / AASHTO M240
 5. Sealer
 6. Statement of Mix Design, prepared by the batch plant servicing the Project, for each type or load delivered to Project. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Each Statement of Mix Design shall include following information:
 - a. Name, address, and telephone number of batch plant preparing Statement of Mix Design.
 - b. Date of Mix Design.
 - c. Project location.
 - d. Contractor requesting load delivery.
 - e. Mix Design Number.
 - f. Cement Type and quantity by volume
 - g. SCM - Post-industrial pozzolan (Fly ash, slag, ground limestone, natural pozzolan) cement substitution as a percentage of the full product composite by volume.
 - h. Admixtures (as required).
 - i. Integral Color Admixtures (as required).
 - j. Gradations for sand and aggregate and RCA content, indicate content by percentage by volume.
 - k. Material weights, specific gravity, and absolute volumes.
 - l. Basis of testing, i.e. UBC 2605 D4 and CBC Title 24 2604 D4.
 - m. Water/Cement Ratio.
 - n. Slump.
 - o. PSI rating.
- B. EPD Information for Concrete Mix Design (As Available per Ready Mix Plant)
1. EPD Submittal:
 - a. Completed Environmental Product Declaration Reporting Form for each concrete mix design.
 - b. For products with completed Environmental Product Declaration Reporting Forms claiming availability of an applicable EPD, provide the Product-Specific or Industry-Wide Type III Environmental Product Declaration (EPD) in compliance with ISO 14025.
 - c. GWP Range: Per mix design
- C. Low Carbon Concrete Compliance
1. This submittal shall indicate the concrete compressive strengths with cement limits measured in lbs/cubic yard per mix design.
 2. Low Carbon Concrete Compliance shall be provided when EPD's are not available.
- D. Certificates:

1. Reinforcing Steel: Certificate of compliance
2. Concrete Mix Design: Ticket for each batch delivered showing the following:
 - a. Mix identification.
 - b. Weight of cement, aggregate, water, and admixtures, aggregate sizes/proportion, and air entrainment.

1.4 QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications: Engage an experienced Installer who has completed in the last two (2) years at least three (3) concrete installations similar in material, design, and extent to that indicated for this Project, and whose work has resulted in construction with a record of successful in-service performance.
- B. Mock-up for exposed finished work: One (1) 4 ft. x 4 ft. x 4 in. for each type of concrete finish and color to serve as standard of quality for all work. Mock-up shall include all jointing details (and insets) for acceptance. Mock-up shall be provided in horizontal or vertical position to match scope.
- C. Lines and Levels: To be established by a licensed Surveyor or registered Civil Engineer.
- D. Design of Concrete Mix: Employ approved commercial testing laboratory to design concrete mixes as follows:
 1. Minimum Compressive Strength at 28 Days:
 - a. Walls and Foundations: 3000 psi
 2. Concrete Slump:
 - a. Minimum: Two (2) inches
 - b. Maximum: Four (4) inches
 3. Maximum Water-Cement Ratio:
 - a. Foundations: 6.75 gallons per sack of cement
- E. Colored Concrete: Achieve color by integrally mixing coloring agent with concrete. Refer to finish schedule for concrete finishes and colors.
- F. Pre-installation Conference: Before installing Work as indicated herein this Section, conduct a Pre-installation Conference at the Project Site with the Landscape Architect to review requirements and design objectives, including a review of concrete textures, colors, finishes, layouts, and other design intents of the Work. Conference shall be held prior to erecting the Field-Constructed Mock-up Samples.
 1. Notify participants in writing at least five (5) working days prior to Conference.
- G. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in a timely manner to ensure un-interrupted progress of the Work.
- B. Store materials in a dry and protected location. Protect reinforcing steel and dowels from rusting, deformation, staining, and moisture damage.

- C. Store materials by methods that prevent damage and permit ready access for inspection and identification. Package cement delivered to the Project Site shall be in strong paper or jute bags with brand name and manufacturer's name stamped thereon. Store cement under cover. Remove packaged cement immediately from the Project Site should it become wet or show any signs of caking or deterioration.

1.6 PROJECT SITE CONDITIONS

- A. Traffic Control: Maintain access for vehicular, bicycle, and pedestrian traffic as required for other construction activities. Access to the surrounding buildings shall also be unobstructed and maintained at all times to allow for entry and exit of emergency vehicles.
- B. Establish and maintain required levels and grade elevations. Review installation procedures and coordinate Work herein this Section with other Work affected.
- C. Do not place site concrete during rain or adverse weather conditions without means to prevent damage. Conform to requirements specified hereinafter whenever concrete placement is required during cold or hot weather.
- D. Keep Work area clean, and in a safe and workmanlike condition so that rubbish, waste, and debris does not interfere with Work of other trades.
- E. Water and Dust Control: Maintain control of concrete dust and water during duration of Contract. Do not permit adjacent planting areas to be contaminated. Clean up debris resulting from this work at the end of each day's Work.

1.7 COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Sequence and Scheduling: Notify contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place, such as:
 - 1. Accessories embedded in the site concrete, and for the provision of holes, openings, etc., necessary to the execution of the Work of the trades.
- B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- D. Excavation: When conditions detrimental to adequate installation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- E. Environmental Conditions: Perform installation operations only when weather and soil conditions are suitable in accordance with locally-accepted practices.

- F. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

PART 2 - PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, wood, MDO plywood, metal, metal-framed plywood, or other approved panel-type materials, of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
1. Provide Forms that are full-depth, continuous, straight and free of distortions and defects, and level or sloping along exposed surfaces.
 2. Provide Forms of sufficient strength and durability to hold concrete properly in place and prevent leakage of water from Forms.
 3. Use flexible spring forms, laminated boards, or foam forms to form continuous and smooth radius bends, as required.
 4. No wood-textured finish from Forms will be permitted on exposed concrete unless specified as such.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments and finishes of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Deformed-Steel Welded Wire Reinforcement (to 70,000psi): Meet ASTM A497, flat sheet. Rolls are not acceptable.
1. Provide material manufactured from 80-100% post-consumer recycled-content materials.
- B. Steel Reinforcement Bars: Meet ASTM A615, Grade 60 deformed, clean and free of rust, dirt, grease or oils.
1. Provide material manufactured from 80-100% post-consumer recycled-content materials.
- C. Steel Bar Mats: Meet ASTM A184 with ASTM A615, Grade 60 deformed bars; assembled with clips.
1. Provide material manufactured from 80-100% post-consumer recycled-content materials.
- D. Steel Tie Wire: 16-gauge minimum, black annealed, plain cold-drawn steel conforming to ASTM A82, clean, and free of rust, dirt, grease or oils.
- E. Construction/Expansion Joint Dowel Bars & Slip Dowel Sleeves:

1. Slip Dowel Sleeve System: A reusable base and plastic sleeve, manufactured from polypropylene plastic. Encase fifty percent (50%) of each dowel in a plastic sleeve to allow parallel lateral movement of each Dowel. Size of Sleeve to match size of Dowel.
 - a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) Speed Dowel, Greenstreak.
 - 2) or equal (no known equal).
 - b. All dowels shall be held in place prior to pour with dowel chairs
- F. Snap Ties: Snap-off metal of fixed length capable of leaving no metal within 1 1/2 in. of surface or causing fractures, spall, or other defects larger than one (1) in. diameter.
- G. Hook Bolts: ASTM A307, Grade A internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- H. Supports for Reinforcement: Lightweight, strong, non-corrosive, durable, and impervious to water. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place, as manufactured from 100% recycled-content plastic or engineered resins from recycled ABS plastic, polycarbonates, and fiberglass.

2.3 CONCRETE MATERIALS

- A. Hydraulic Blended Cement: Meet ASTM C595. Use one (1) brand of cement (single source) throughout the Project, unless otherwise acceptable to the Landscape Architect. Contractor shall verify the cement color with the Landscape Architect. Cement Types as follow:
 1. Cement Type: Type IL Portland-Limestone Cement
 2. Cement Type: Type IS Portland-Slag Cement
 3. Cement Type: Type IP Portland-Pozzolan Cement: Portland-pozzolan cement with moderate sulfate resistance properties
 4. Cement Type: Type IT Ternary Blended Cement
- B. ASTM C1157 Cement Performance Types:
 1. Type MS: Moderate Sulfate Resistance
 2. Type LH: Low Heat of Hydration
 3. Type GU: General Use
 4. Type HE: High Early-Strength
 5. Type HS: High Sulfate Resistance
 6. Type MH: Moderate Heat of Hydration
- C. Portland Cement: Meet ASTM C150. Use one (1) brand of cement (single source) throughout the Project, unless otherwise acceptable to the Landscape Architect. Contractor shall verify the cement color with the Landscape Architect. Cement Type as follows:
 1. Cement Type: Type I.
 2. Cement Type: Type II/V.
 3. Cement Type: Type III.
- D. Aggregate: ASTM C 33, uniformly graded, from a single source, gray in color only, with coarse aggregate as follows:

1. Class: 4M.
 2. Maximum Aggregate Size: 3/4 inch nominal.
 3. Do not use fine or coarse aggregates containing substances that cause spalling.
- E. Normal-Weight Recycled Concrete Aggregates (RCAs): Meet ASTM C33, Class 1N, and as follows:
1. Fine Aggregates: Meet ASTM C33, clean, hard, non-reactive, and durable sand. Do use sand coated with injurious amounts of silt, loam, clay or other deleterious matter.
 2. Grading Requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100%
No. 4	95-100%
No. 8	80-100%
No. 16	50-85%
No. 30	25-60%
No. 50	5-30%
No. 100	0-10%

3. Coarse Recycled Concrete Aggregates: Meet ASTM C33, hard, durable, non-reactive, un-coated, graded, cleaned, and screened crushed rock or gravel aggregate for regular weight concrete. Do not use crusher-run stone or bank-run gravel. Aggregate shall be from a single source and shall be like in visual appearance.
 - a. Grading: Do not use Coarse Aggregate which has a maximum size exceeding 1/5 of the narrowest dimension between sides of forms of the member for which concrete is to be used, nor larger than 3/4 of the minimum clear spacing between reinforcing bars.
 - 1) Do not use coarse Aggregate for pavements which exceeds 3/4 inch diameter.
 - 2) Do not use coarse aggregates that contain substances that cause spalling.
4. Fine Recycled Concrete Aggregate:
 - a. Description: ASTM C33, clean, hard and durable sand. Do not use sand coated with injurious amounts of silt, loam, clay or other deleterious matter.
 - b. Grading Requirements:

<u>Percent Passing</u>	<u>Sieve Size</u>
45-70	# 16
15-30	# 50
3- 8	#100

- c. Local aggregates not complying with ASTM C33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to the Landscape Architect.
- F. Supplementary Cementitious Materials (SCM):
1. Fly Ash: Flyash: Pozzolanic admixtures, conforming to ASTM C618, Class C or Class F, with weight loss of ignition limited to not to exceed 3 percent shall be used in mix

designs to replace Portland Cement. Final replacement value to be determined by the ready-mix plant and shall be coordinated with the use of PLC Type IL MS/LH, ASTM C595 Compliant.

2. Ground Granulated Iron Blast-Furnace Slag: Meet ASTM C989.
3. Silica Fume: Meet ASTM C1240
4. Natural Pozzolans: Meet ASTM C618
5. Reference: ACI 211.4R-93.

- G. Water: Per ASTM C1602, from potable domestic source, free from deleterious materials such as oils, acids, and organic matter.

2.4 CHEMICAL ADMIXTURES FOR CONCRETE

- A. General: Admixtures shall be certified by the Manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other Admixtures. Use of Admixtures shall not relieve the Contractor of the designated concrete requirements, including strength.
- B. Air-Entraining Admixture: Meet ASTM C260.
- C. Water-Reducing Admixture: Meet ASTM C494, Type A.
- D. Water-Reducing and Set Retarding Admixture: Meet ASTM C494, Type B and D.
- E. Shrinkage-Reducing Admixture: Meet ASTM C157. Provide at dosage of 2% by weight of cement.
- F. Integral Concrete Coloring Admixture: Provide materials specifically designed for use in ready-mix concrete, from a single source, and shall be like in color and visual appearance. Meet ASTM C979. Refer to Section 32 1316 "Decorative Concrete Paving".

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces / square yard dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- E. Products: Subject to compliance with requirements, provide one of the following:
1. Clear Waterborne Membrane-Forming Curing Compound which will not affect the final surface color or finish:

2.6 RELATED MATERIALS

- A. Expansion Joint Materials:
1. W.R. Meadows or equal, Ceramar flexible foam expansion joint 1/4 inch
 2. Metal keyway with 1/4 inch pull strip and foam expansion material.

3. Joint Sealant: ASTM C290, non-slag sealant
4. Bond Breaker: Pressure-sensitive tape as recommended by sealant manufacturer to suit application.

2.7 CONCRETE MIXES AND PROPORTIONING

- A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength for each type of normal-weight concrete in accordance with current edition of ACI's "Manual of Concrete Practice" and the PCA's "Design and Control of Concrete Mixtures".
 1. Use transit mixer trucks equipped with automatic devices for recording number of revolutions of drum.
- B. Slump: Adjust quantity of water so concrete at point and time of discharge does not exceed the aforementioned slumps when tested per ASTM C143. Use the minimum water necessary for workability required by part of item being cast.
- C. Proportion Concrete Mixes to provide Low Carbon Concrete with the following properties:
 1. Vehicular Paving Use Areas:
 - a. Compressive Strength (28 Days): Minimum 4,000 PSI.
 - b. GWP Cap: 300 kg CO₂e /m³ (as verified by concrete submittal) , and/or
 - c. Cement Limit (lbs/cubic yard): 456
 - d. Maximum Water-Cementitious Materials Ratio: 0.45.
 - e. Slump Limit: 4 inches.
 2. Pedestrian Paving Use Areas and Stairs:
 - a. Compressive Strength (28 Days): Minimum 3,000 PSI.
 - b. GWP Cap: 275 kg CO₂e /m³ (as verified by concrete submittal) , and/or
 - c. Cement Limit (lbs/cubic yard): 410
 - d. Maximum Water-Cementitious Materials Ratio: 0.45.
 - e. Slump Limit: 5 inches.
 3. Walls and Footing
 - a. Compressive Strength (28 Days): Minimum 4,000 PSI.
 - b. GWP Cap: 300 kg CO₂e /m³ (as verified by concrete submittal) , and/or
 - c. Cement Limit (lbs/cubic yard): 456
 - d. Maximum Water-Cementitious Materials Ratio: 0.45.
 - e. Slump Limit: 4 inches.
- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials (other than Portland Cement) in concrete as follows"
 1. Supplemental Cementitious Material (SCM) for Low Carbon Concrete (LCC): Final type and weight of cementitious replacement materials to be provided by the Ready-Mix Plant. SCMs used shall help to meet the GWP cap as noted in the mix design reequipments.
 - a. GGBFS: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - b. Pozzolans: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - 1) Fly Ash: As recommended by the Ready-mix plant to hit reduced GWP values for LCC

- 2) Natural Pozzolan: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
 - 3) Silica Fume: As recommended by the Ready-mix plant to hit reduced GWP values for LCC
- E. Add Air-Entraining Admixture at the Manufacturer's prescribed rate to result in concrete at point of placement. If used, do not exceed two-percent (2%).
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 1.5 percent:
 1. Air Content: 5.5 percent for 1-1/2-inch maximum aggregate.
 2. Air Content: 6.0 percent for 1-inch and 3/4-inch maximum aggregate.
- G. Shrinkage Reducing Admixture at 1 gallon used per cubic yard of concrete to reduce cracking.
- H. Coloring Agent: Add coloring agent to mix according to Manufacturer's written instructions. See drawings for color and manufacture information.
- I. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.
- J. Concrete Delivery: Use of concrete loads exceeding ninety (90) minutes from time of batch plant must be approved by the Landscape Architect
- K. Ensure that the batch plant guarantees a single-source supply for Cement, Sand, and Aggregate for the entire project.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C94.
- B. When air temperature is between 85 deg. F. (30 deg. C.) and 90 deg. F. (32 deg. C.), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F. (32 deg. C.), reduce mixing and delivery time to 60 minutes.

2.9 ACCESSORIES

- A. Form Release Agent: Colorless non-staining, free from oils. Chemical agent shall not impair bonding of paint or other proposed coatings.
- B. Wood Headers:
 1. Wood: Construction Heart grade rough Redwood header and stake or pressure-treated rough Douglas Fir stake.
 2. Nails: Hot-dipped galvanized.
- C. Dampproofing: ASTM C836-81, Fluid-V single component, bitumen-modified, moisture-curing polyurethane "Tremproof 60" by Tremco, (800) 321-7906.
- D. Curing Compound: ASTM C309, Type I-D, Class A.
- E. Chamfer Strips: Rigid PVC, or hardwood per drawings in maximum possible lengths
- F. Slip Sheet: 40 mil PVC sheet or 15 lb. felt

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

3.2 EXAMINATION

- A. Proof-roll prepared sub-base surface for foundations to check for unstable areas and verify need for additional compaction. Verify that sub-grade preparation for site concrete has been completed including base course prior to commencement of Work.
- B. Surface Drainage:
 - 1. Report in writing conflicts discovered on the site or prior Work done by others, which would prevent positive drainage.
 - 2. Do not permit finished site concrete surfaces to vary more than 1/4 in. measured with a 10 ft. metal straightedge, except at grade changes. Properly correct irregularities.

3.3 PREPARATION

- A. Templates: Use templates for anchor plates, bolts, inserts and/or other items embedded in concrete. Accurately secure so that they will not be displaced during placing of concrete.
- B. Piping and Conduit: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain strength of structures at maximum. Verify size, length and location of electrical conduit.
- C. Aggregate Base Course: Compact base course to thicknesses as shown on Contract Drawings or as indicated per the Geotechnical Report, to the relative compaction density as required per the Geotechnical Report. Aggregate Base Course shall be graded to the lines and levels indicated; no ruts or depressions shall be allowed.
- D. Gravel Fill or Sand Beds: Re-compact disturbed gravel fill or sand beds and bring to correct elevation.

3.4 FORMWORK

- A. Design, construct, erect, shore, brace, and maintain Formwork according to ACI 347 "Guide to Formwork for Concrete."
- B. Formwork shall be consistent with the orientation and pattern indicated on the Contract Drawings. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install Formwork to allow continuous progress of Work and so that Formwork can remain in place at least twenty-four (24)-hours after concrete placement.
- C. Coordinate locations of drainage piping requirements, irrigation piping stub-outs, electrical conduits, or other items scheduled to be embedded into cast concrete.

- D. Check completed Formwork and screeds for grade and alignment to following tolerances:
 - 1. Top of Forms: Not more than 1/8 inch in ten- (10) feet.
 - 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in ten-(10) feet.
- E. Coat Form Work with Form Release Agent, as required, to ensure Form Work separates from casted concrete without damage to concrete's finished surface.
 - 1. Formwork surfaces shall be clean, dry, and free from contaminants (dirt, dust, rust, build-up, and existing form agents) prior to each use of Formwork
 - 2. Prior to each use, Formwork that comes into direct contact with concrete shall be coated with Form Release Agent in accordance with the Manufacturer's written instructions.
 - 3. Apply Form Release Agent in a uniform and even manner by low pressure spray, roller, or clean cloth, in accordance with the Manufacturer's written instructions.
 - 4. Prior to coating new Formwork, apply one (1) or two (2) heavy coats to edges for waterproofing protection.
 - 5. Excess Form Release Agent or dense form surfaces should be removed with a clean cloth.
 - 6. Do not apply Form Release Agent to reinforcing steel.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.
- B. Clean Reinforcement of loose rust and mill scale, earth, or other bond-reducing materials.
- C. Arrange, space, and securely Tie Bars and Bar Supports to firmly hold and support the Steel Reinforcement in position during concrete placement and to prevent displacement before or during casting. Maintain a minimum of two inches (2") cover to the Reinforcement.
- D. Install Steel Reinforcement Bars in sizes as indicated on the Contract Drawings, in lengths as long as practicable. Lap adjoining Bars at a minimum of fifty (50) bar diameters. Lace splices accordingly with Tie Wire. Offset laps of adjoining widths to prevent continuous laps in either direction. Erect and maintain Reinforcement Bars on chairs, secured firmly in position, in the middle of the concrete during casting operations. Do not extend Reinforcement Bars through expansion joints.
- E. Install Construction Joint Dowel Bars & Sleeves per the Manufacturer's recommendation. Reinforcing dowels, or sleeves for the reinforcing dowels, shall be secured in place prior to placing concrete. Align dowels in straight, even alignments in the middle of the concrete profile during casting operations. Dowels and sleeves shall not be pressed into the concrete during casting and after the concrete has been placed.
- F. Install fabricated Steel Bar Mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum two-inch (2") overlap to adjacent mats.
- G. Vapor Barrier: If provided, do not cut or puncture Vapor Barrier. Repair damage and reseal Vapor Barrier before placing concrete.

3.6 CONCRETE PLACEMENT

- A. Preparation: Remove all free water from forms before concrete is deposited. Remove hardened concrete, debris, and foreign materials from interior surfaces of forms, exposed reinforcing, and from surfaces of mixing and conveying equipment.
- B. Sub-Base: Sub-Base shall be free of ruts, holes, ridges, etc. Smooth and compact sub-base to an even plane.
- C. Wetting: Wet wood forms sufficiently to tighten up cracks. Wet other materials sufficiently to reduce absorption and to help maintain concrete workability. Dampen earth sub-grade twenty-four (24) hours before placing concrete, but do not muddy. Re-roll where necessary for smoothness, and remove loose material from compacted sub-base surface prior to placing concrete.
- D. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, dowels/sleeves, and items to be embedded or cast in. Notify other trades to permit installation of their Work.
 - 1. Reinforcement and Forms shall be secured firmly in position such that they will not be displaced during the placement of concrete.
 - 2. Reinforcement Bars, Ties, and Welded Wire Fabric shall be completely encased in concrete, at a minimum of two-inches (2") from any edge of the concrete.
 - 3. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- E. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate site concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations.
- I. When adjoining concrete lanes are placed in separate pours, do not operate equipment on concrete until concrete has attained eighty-five-percent (85%) of its fully hydrated compressive strength.
- J. Cold-Weather Placement: Comply with ACI 306.1, and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg. F. (4.4 deg. C.), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F. (10 deg. C.) and not more than 80 deg. F. (27 deg. C.) at point of placement.
 2. Do not use calcium chloride, salt, or other materials containing anti-freeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- K. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg. F. (32 deg. C.). Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, reinforcement steel, and sub-grade just before placing concrete. Keep sub-grade moisture uniform without standing water, soft spots, or dry areas.

3.7 JOINTS

- A. General: Refer to ACI 302 "Guide for Concrete Floor and Slab Construction" for work under this Article. Construct construction, isolation, expansion, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
1. When joining existing paving, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of site concrete and at locations where site concrete operations are stopped for more than one-half (1/2) hour, unless site concrete terminates at isolation joints.
1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of site concrete strips, unless otherwise indicated on the Contract Drawings.
 2. Provide tie bars at sides of site concrete strips where indicated.
 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, buildings, foundations, walls, other fixed objects, and in other locations as indicated on the Contract Drawings. Provide Expansion Joints at full depth of site concrete where site concrete meets vertical faces of buildings, structures, foundations, walls, etc.
1. Locate expansion joints at maximum intervals of twenty (20) feet, unless otherwise indicated on the Contract Drawings.
 2. Extend joint fillers full width and depth of joint.
 3. Provide Construction Joint Dowel Bars at the spacing distances indicated in the Contract Drawings.

4. Terminate Joint Filler less than 1/2 inch or more than one-inch (1") below finished surface if joint sealant is indicated.
 5. Place top of Joint Filler flush with finished concrete surface if joint sealant is not indicated.
 6. Furnish joint fillers in one (1)-piece lengths. Where more than one (1) length is required, lace or clip joint-filler sections together.
 7. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints and Isolation Joints: Form weakened-plane contraction joints and isolation joints, sectioning concrete into areas as indicated on the Construction Drawings, or at spacing intervals as recommended by the PCA.
1. General Methodology: Contraction Joints shall be placed in Site Concrete to minimize the occurrence of random cracking on the surface due to drying shrinkage or stress loading and to reduce the width of concrete cracks should they occur. When not indicated on the Contract Drawings, Contraction Joints shall be placed at 24x the thickness of the site concrete.
 2. Tooled (Grooved) Contraction Joints:
 - a. Form Tooled (Grooved) Joints in fresh concrete after initial floating using a jointer to cut the above the groove so that a smooth, uniform impression is obtained. Strike joints before and after floating and troweling.
 - b. Perform in a continuous operation to avoid misalignment of joints. Use snap-lines and forms, as required, to achieve consistent lines. Re-form crooked or misaligned joints at no cost to Owner.
 - c. Radius: 1/8 inch.
 - d. Depth: Construct depth equal to a minimum of one-fifth (1/5) of the concrete slab thickness.
 3. Saw-Cut Contraction Joints:
 - a. Construct Saw-Cut Contraction Joints with a circular power saw, equipped with a new, shatterproof abrasive or diamond-tipped blade. Cut 3/16-inch-wide joints (maximum width of saw-blade) into concrete surface. Cutting action shall not tear, abrade, spall, shatter, or otherwise damage the surface.
 - b. Saw-cut concrete surface when successful jointing results can be achieved and prior to uncontrolled random contraction cracking of concrete occurs.
 - 1) Early-entry Sawcuts: When used, provide sawcuts into fresh concrete at 1" to 1-1/4" depth, or as indicated on the Contract Drawings.
 - c. Perform saw-cut joints cleanly and smoothly, to a constant and equal depth, in a continuous consistent line, with no over-cutting.
 - d. Depth:
 - 1) Contraction Joints: Construct depth equal to a minimum of one-fifth (1/5) of the concrete slab thickness.
 - 2) Isolation Joints: Construct depth equal to the full depth of the concrete thickness.
 - e. Perform in as continuous an operation as possible, to avoid misalignment of joints. Use chalk lines, forms, or templates as required, to achieve consistent lines)

- f. Use a hand grinder with a 4-inch diamond blade to saw-cut up to vertical edges such as walls, steps, curbs and columns. Do not over-cut into vertical surfaces or adjacent concrete surfaces.
- E. Edging: Tool edges of site concrete, as required, after initial floating, with an edging tool to the following radius or chamfer. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
 - 1. Radius: 1/4 inch (aka "Carpet Edger").

3.8 CONCRETE FINISHES

A. General:

- 1. Finished site concrete surfaces indicated herein this Section shall be "slip-resistant", per the requirements outlined in and per ADAAG 4.5.1.
 - a. The minimum coefficient of friction shall meet or exceed 0.8 on exterior and 0.6 on interior surfaces.
 - b. Site concrete surfaces shall have the following finish on all surfaces less than six percent (6%) slope:
 - 1) Medium Broom Textured Finish or a textured finish as specified which is equivalent to the finished texture of a Medium Broom Textured Finish.
 - c. Site concrete surfaces shall have the following finish on all surfaces greater than six percent (6%) slope:
 - 1) Heavy Broom Textured Finish or a textured finish as specified which is equivalent to the finished texture of a Heavy Broom Textured Finish.
 - d. Color(s) and finish(es) specified herein shall match referee samples and field-constructed mock-up samples as approved by the Landscape Architect.
 - e. Wetting of concrete surfaces during screeding, initial floating, or finishing operations is strictly prohibited.

B. Float Finish:

- 1. Applications: Provide Float finish for Veneer Unit Paving Sub-slabs. Provide in areas as indicated on Contract Drawings.
- 2. After initial screeding and floating, commence a second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Re-float surface immediately to uniform granular texture.
 - a. Float Texture: Use aluminum or magnesium float to produce medium texture.
- 3. Provide contraction jointing and edging, as required, in the locations indicated in the Contract Drawings, and of the type(s) indicated herein this Section.
- 4. After concrete is fully hydrated (approx. 30-days), seal float texture finished concrete surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.

C. Broom Finish:

- 1. Obtain by drawing a stiff bristled broom across a floated finish.
- 2. Direction of brooming to be perpendicular to direction of paving (or as shown on Drawings.)

3. Exposing of Aggregates: Do not dislodge or unevenly expose the aggregates. Avoid direct hosing of the surface and do not use a pressurized nozzle.
- D. Steel-Trowel Finish:
 1. Float finish as specified above.
 2. After surface water disappears and floated surfaces have sufficiently hardened, power trowel to produce an even smooth surface.
- E. After concrete has set enough to ring trowel, retrowel to a uniform smooth finish, free of trowel marks or other blemishes. Avoid excessive troweling that produces burnished areas.

3.9 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Protection:
 1. Protect concrete against rapid drying and damage by rain and freezing conditions
 2. Keep concrete moist for at least 7 days. Protect with liquid curing compound, or a covering that will not stain or discolor finished concrete surfaces. Obtain acceptance of proposed method prior to use.
- C. Spraying: Spray concrete during the curing period as frequently as drying conditions may require.
- D. Curing: Cure concrete in accordance with the ACI Manual of Concrete Practice. During curing period, maintain concrete above 70 degrees F. for at least 3 days or above 50 degrees F. for at least 5 days.
- E. Damage and Defacement: Protect all concrete work against damage and defacement during subsequent construction operations until final acceptance.

3.10 INSTALLATION OF JOINT SEALANTS

- A. Provide a Joint Sealant that is compatible with the substrate material(s) to which it is being applied. Do not use a Joint Sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the application tool.
- B. Ambient Temperature Criteria: The ambient temperature shall be within the limits of 40d. F. and 90d. F. when the Joint Sealant is being applied.
- C. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of Joint Sealants as applicable to materials, applications and conditions indicated.
- D. Surface Preparation of Joints:
 1. Remove foreign material from joint substrates which could interfere with adhesion of Joint Sealant, including dust, surface dirt, dirt, moisture, water repellents, grease, oil, wax, lacquer, paint, waterproofing, or other foreign matter that would tend to destroy or impair adhesion.
 2. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths.

3. Clean porous surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or acid washing to produce a clean, sound substrate. Remove loose particles remaining from cleaning operations by vacuuming or blowing out joints.
 4. Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing.
 5. Clean non-porous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of Joint Sealants.
- E. Sealant Preparation: Do not add liquids, solvents, or powders to the Joint Sealant material (for single-component materials). Where specified, mix multi-component elastomeric Joint Sealants in accordance with manufacturer's instructions.
- F. Primer: Immediately prior to application of the Joint Sealant, clean out loose particles from joints. Where recommended by the sealant manufacturer, apply Primer to joints in accordance with sealant manufacturer's instructions. Do not apply Primer to exposed finish surfaces. Do not allow spillage or migration of Primer onto adjoining surfaces.
- G. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
1. Install Joint Fillers to provide sealant support for optimum performance cross-sectional shapes and depths.
 - a. Do not leave gaps between ends of Joint Fillers.
 - b. Do not stretch, twist, puncture or tear Joint Fillers.
 - c. Remove absorbent Joint Fillers which have become wet prior to sealant application and replace with dry material.
 2. Install Bond Breaker to the back or bottom of the joint cavity (between sealants and joint-fillers, compression seals or back of joints where required), as recommended by the Joint Sealant manufacturer, for each type of joint and sealant used, to prevent "third-side" adhesion of the Joint Sealant to the back of the joint. Carefully apply the Bond Breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the Bond Breaker.
- H. Installation of Joint Sealants:
1. Install Joint Sealant after concrete substrate material has been cast and allowed to cure. Remove protective cap from preformed Joint Filler. Remove any excess Joint Filler material that will inhibit an adequate depth and bond of the Joint Sealant material.
 2. Place masking tape where required along the joint cavity to prevent contact of the Joint Sealant with adjoining surfaces. Remove masking tape within ten (10) minutes after joint has been filled and tooled.
 3. Apply the Joint Sealant in accordance with the manufacturer's printed instructions with an application tool having a nozzle that fits the width of the joint cavity. Install Joint Sealant by proven techniques to contact and solidly full wet joint substrates, completely filling the recesses provided for each joint configuration, providing uniform, optimum performance cross-sectional shapes and depths. Do not allow spillage or migration of Joint Sealant onto adjoining surfaces.
- I. Tooling of Non-Sag Joint Sealants: Tool Non-Sag Joint Sealants to form smooth, uniform beads of configuration indicated, free of wrinkles, streaks, gouges, boils, air holes, etc. and to ensure contact and adhesion of the Joint Sealant with the sides of the joint. Remove excess Joint

Sealants from surfaces adjacent to joint. Do not use tooling agents which discolor Joint Sealants or adjacent surfaces or are not approved by Sealant Manufacturer.

- J. Sanding of Joint Sealant: Lightly apply dry sand to cover freshly-poured elastic Joint Sealant material. When Joint Sealant has hardened, remove excess sand that has not bonded to Joint Sealant.
- K. Protection and Curing:
 - 1. Protect installed Joint Sealants during and after curing period from contact with contaminating substances or from damage.
 - 2. Cut out and remove damaged or deteriorated Joint Sealers and reseal joints with matching new materials.
 - 3. Clean off excess Joint Sealants or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved by the Sealant Manufacturer.

3.11 REPAIRS AND PROTECTION

- A. Remove in its entirety (from joint to joint) and replace site concrete that is broken, cracked, damaged, or defective, or concrete which does not meet requirements of this Section.
- B. Protect concrete from damage. Exclude traffic from site concrete for at least fourteen (14) days after placement. When construction traffic is permitted, maintain site concrete as clean as possible by removing surface stains and spillage of materials as they occur.
- C. Maintain exposed site concrete free of stains, discoloration, dirt, and other foreign material. Clean site concrete not more than two (2) days before date scheduled for Substantial Completion inspection.

3.12 DAMPPROOFING

- A. Preparation of Surfaces:
 - 1. Clean all surfaces to be dampproofed. Remove all dirt, grease, and other foreign matter which might interfere with adhesion and penetration. Allow surfaces to dry thoroughly.
 - 2. Carefully repair all cracks, holes, voids, open areas and other defects in concrete surfaces to be dampproofed. Use Portland Cement mortar; strike flush and permit to dry.
 - 3. Thoroughly clean all excess mortar from concrete surfaces after drying.
- B. Application of Dampproofing Compound:
 - 1. Cover entire retaining surface of backside of walls from top of footing to finished grade with specified dampproofing. Apply according to manufacturer's current printed instructions.
 - 2. Apply dampproofing in a clean line conforming to finished ground grade.
 - 3. Provide a completed dampproofing coating which is a continuous, uniform, unbroken, impervious film, free from pinholes and other surface breaks.

3.13 FIELD QUALITY CONTROL

- A. Samples: Owner will select a qualified testing laboratory to take samples for testing during the course of the work as considered necessary.

- B. Cost of Testing: Paid for by the Owner.
- C. Rejected Materials: Remove off the site all concrete below specified strength.
- D. Cost of Removal and Retesting: Pay for full costs of removal of rejected concrete and its replacement with concrete of specified strength and retesting.

END OF SECTION

SECTION 321400 - UNIT PAVING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required, to make a complete, universally-accessible Unit Paving installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Precast Concrete Unit Paving Modules.
 - 2. Compaction of Soil Sub-Grade.
 - 3. Graded Aggregate Sub-Base Material.
 - 4. Sand Bedding Material (Sand for Leveling/Bedding Course).
 - 5. Joint Filler Material (Polymer-Modified (Polymeric) Finishing Sand for Paving Joints).
 - 6. Accessories (Geotextile Filter Fabric,).
 - 7. Unit Paving Sealant.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 31 22 19, "Landscape Fine Grading".
 - 2. Section 32 13 13, "Landscape Architectural Cement Concrete Paving".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
 - 3. AASHTO – American Association of State Highway and Transportation Officials.
 - 4. NBGQA - National Building Granite Quarries Association.
 - 5. ICPI – Interlocking Concrete Pavement Institute.
 - 6. NSTC – National Slate Technology Center.
 - 7. BIA – Brick Industry Association.
 - 8. BSI – Building Stone Institute.
 - 9. ADAAG – American with Disabilities Act Accessibility Guidelines.
- B. Material Specification Standards:
 - 1. ANSI A118.4 – Standard Specification for Latex-Portland Cement Mortar.
 - 2. ASTM C33 – Standard Specification for Concrete Aggregates.
 - 3. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar.
 - 4. ASTM C936 – Standard Specification for Solid Concrete Interlocking Paving Units.
 - 5. ASTM D2940 – Standard Specification for Graded Aggregate Material for Bases or Sub-bases for Highways or Airports.
- C. Material Testing Standards:

1. ASTM C97 – Standard Test Method for Absorption and Bulk Specific Gravity of Dimension Stone.
2. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
3. ASTM C140 – Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
4. ASTM C170 – Standard Test Method for Compressive Strength of Dimension Stone.
5. ASTM C241 – Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic.
6. ASTM C880 – Standard Test Method for Flexural Strength of Dimension Stone.
7. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
8. ASTM D1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

D. Measurements:

1. PSI: Measurement, in pounds per square foot.
2. CU/FT: Measurement, in cubic-foot.
3. Percent Compaction: Per ASTM D1557, percentage of the maximum in-place dry density of the same material, as determined by the Geotechnical Engineer.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Product/Material Data. Submit available Product/Material data, manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of material and product indicated:
 1. Precast Concrete Unit Pavers.

2. Joint Filler Material.
 3. Accessories (Geotextile Filter Fabric, Soil Sterilant).
 4. Finished Surface Sealer.
- H. Material Samples: Submit Material Sample sets as indicated to the Landscape Architect for verification:
1. In full-size Units, submit Sample sets of each type of Unit Paving indicated herein this Section. Provide Sample sets of each size and shape for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics:
 2. 12" x 12" square panel of Geotextile Filter Fabric.
 3. One (1) pound sample of Graded Aggregate Sub-base material. Submit in re-sealable plastic bag, and label accordingly.
 4. One (1) pound sample of Sand for Leveling/Bedding. Submit in re-sealable plastic bag, and label accordingly.
 5. One (1) pound sample of Joint Filler Material (Polymer-Modified (Polymeric) Joint Sand). Submit in re-sealable plastic bag, and label accordingly.
 6. Full size paver units with applied sealant.
- I. Material Test Reports: Submit test results from an independent testing laboratory for compliance of each type of material specified, per associated ASTM standards. Cost of testing shall be borne by the Contractor.
1. Unit Paving Modules:
 - a. Test Units for compressive strength, water absorption, and dimensional tolerance per ASTM C140.
 - b. A minimum of five (5) full size Units per test are required for an average value.
 2. Graded Aggregate Sub-base Material: Sieve analysis per ASTM D448, meeting ASTM D2940 gradation.
 3. Sand Bedding Material (Sand for Leveling/Bedding Course): Sieve analysis per ASTM C136, meeting modified ASTM C33 gradation.
 4. Joint Filler Material (Polymer-Modified (Polymeric) Joint Sand): Sieve analysis per ASTM C136, meeting modified ASTM C144 gradation.
- J. Field-Constructed Mock-ups:
1. Provide complete Field-Constructed Mock-ups for all respective materials receiving finishing which is to be used as the basis for judging quality of workmanship throughout the project, as follows:
 - a. Size: Provide one (1) Field-Constructed Mock-up for each Unit Paving type indicated herein this Section. Each Mock-up shall measure 6'-0" wide x 8'-0" long, and include each type of edge restraint material at the perimeter of the Mock-up as indicated per the Contract Drawings.
 2. Prior to the installation of Work in this Section, erect Field-Constructed Mock-ups to verify selections made under the Submittals Article herein to demonstrate aesthetic effects as well as qualities of materials and execution. Build Field-Constructed Mock-ups to comply with the following requirements, using materials indicated for final Unit of Work, including same base construction, joints, and contiguous Work as indicated.
 3. Locate Field-Constructed Mock-ups in the location and of the size indicated or, if not indicated, as directed by the Owner.
 4. Notify the Landscape Architect at least one (1) week in advance of the dates and times when the Field-Constructed Mock-ups will be erected and ready for review.

5. Demonstrate the proposed range of aesthetic effects and workmanship in the Field-Constructed Mock-ups that will be produced in final Unit of Work.
 6. When the Landscape Architect determines that Field-Constructed Mock-ups does not meet requirements, retain it for reference and construct additional Field-Constructed Mock-ups until it is accepted. Modify or correct Work as directed by Landscape Architect.
 7. Obtain the Landscape Architect's acceptance of the Field-Constructed Mock-ups, in writing, prior to the start of the final Unit of Work. Accepted Mock-ups is a prerequisite to commencing Work under this Section.
 8. Retain and maintain Field-Constructed Mock-ups during construction in an undisturbed condition. Accepted Field-Constructed Mock-ups shall be the standard for judging the completed Work under this Section.
 9. Demolish and remove the Field-Constructed Mock-ups when directed by the Owner.
 10. Accepted Field-Constructed Mock-ups may become part of the completed Work, if directed by the Landscape Architect.
 11. Final mock-up shall include preliminary approved sealer for final approval. One mock-up with applied sealer (4 pavers minimum) shall be required for each paver color selected.
- K. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Unit Paving installations.
- L. Maintenance Program: Submit Manufacturer-recommended program for maintenance of each type of Unit Paving indicated herein.

1.4 QUALITY ASSURANCE AND CONTROL

- A. Manufacturer Qualifications: Each Manufacturer shall specialize in the manufacturing of Unit Paving Materials for a minimum of five (5) years.
- B. Installer Qualifications:
1. Engage an experienced Installer who has completed Unit Paving installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance. Installation shall be by a Contractor and crew with at least two (2) years of experience in placing Unit Paving on projects of similar nature and dollar cost.
- C. Single-Source Responsibility: Obtain each color, type, and variety of Unit Paving type, joint materials, and setting materials from a single source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
- D. Manufacturer's Directions: Follow Manufacturer's directions and drawings in cases where the Manufacturers of articles used in this Section furnish directions covering points not shown in the Contract Drawings and Contract Specifications.
- E. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide new, unused materials indicated under this Section. Store and secure properly to prevent theft or damage. It is the responsibility of the Contractor to install "factory condition" Units.
- B. Deliver perishable materials in original, unopened packaging. Protect from dampness.
- C. Deliver materials in a timely manner so as to not delay Work, and install only after preparations for installation have been completed.
- D. Protect Unit Pavers and other materials during storage and construction against soilage or contamination from earth and other materials.
 - 1. Wrap pavers in plastic or use other packaging materials that will prevent rust marks from steel strapping used in shipping.
 - 2. Deliver and unload materials at the Project Site in such a manner that no damage occurs to the products or materials.

1.6 COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- D. Excavation: When conditions detrimental to installing Unit Paving is encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease installation operations and notify Landscape Architect for further direction.
- E. Traffic Control: Maintain access for vehicular, bicycle, and pedestrian traffic as required for other construction activities during installation of Unit Paving. Access shall also be unobstructed and maintained at all times to allow for entry and exit of emergency vehicles.
- F. Grades and Levels: Establish and maintain required levels and grade elevations. Review installation procedures and coordinate Work herein this Section with other Work affected.
- G. Weather: Perform installation of Unit Paving only when weather and soil conditions are suitable in accordance with locally accepted practices. Do not install Unit Pavers during rain or while sub base is wet from rain. Do not apply Soil Sterilant when winds exceed ten (10) mph or during or immediately after rain.
 - 1. Hot-Weather Requirements: Protect Unit Paving Work in hot weather by providing artificial shade, wind breaks and use cooled materials, as required.
- H. Sequence and Scheduling: Do not install Work under this Section prior to acceptance of sub-grade preparation Work under another Section. Install edging/header materials prior to

placement of Unit Paving. Coordinate with other trades to insure proper placement of irrigation sleeves (per Section 32 8400) prior to installation of Unit Paving.

- I. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

1.7 EXTRA MATERIALS

- A. Provide additional Unit Pavers to the Owner to be used for future repairs. Deliver surplus Unit Pavers on pallets, as required, per the requirements of the Delivery, Storage and Handling Article.
 1. Quantity: Provide a minimum of one-percent (1%) of the total quantity installed of each Unit Paving in each respective Unit size as indicated herein this Section, unless quantity is otherwise noted

1.8 SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE UNIT PAVING MODULES

- A. General: Provide materials and products that result in consistent colors, styles, textures, and patterns of the Precast Concrete Unit Paving surfaces. Install in necessary quantity in areas as indicated on the Contract Drawings.

- B. Type: Solid, interlocking Precast Concrete Unit Paving modules, manufactured to comply with ASTM C936, made from normal-weight aggregates in colors, texture, density, sizes, and shapes as indicated.
- C. Dimensional sizes: (as expressed in the ratio of length x width):
 - 1. Refer to Contract Drawings
- D. Thickness:
 - 1. Refer to Contract Drawings
- E. Testing and Physical Properties:
 - 1. Test Units prior to delivery to the project in accordance with ASTM for average compressive strength, average water absorption, freeze/thaw resistance, and dimensional tolerance. A minimum of five (5) specimens per test are required for an average value. Compile tests using full size Units, meeting the following:
 - a. Average Compressive Strength: Meet or exceed 8,000 PSI, per ASTM C140, with no individual unit under 7,200 PSI.
 - b. Average Water Absorption: 5%, with no Unit greater than 7%, per ASTM C140.
 - c. Freeze/Thaw Resistance: Resistant to fifty (50) freeze/thaw cycles with no greater than 1% loss of material, per ASTM C67.
 - d. Dimensional Tolerances:
 - 1) Length or width: Units shall not differ by more than 1/16" from approved samples.
 - 2) Height/Thickness: Units shall not differ by more than 1/8" from the specified standard dimensions.
 - 2. Rejection: In the event the Units fail to conform to the specified testing requirements, the Manufacturer may sort it, and new test Units shall be selected at random by the Landscape Architect from the retained lot and tested at the expense of the Manufacturer. If the second test of test Units fails to conform to the specified requirements, the entire lot shall be rejected.
- F. Colors: Pigments used in the manufacture of the Units shall conform to ASTM C979. Provide Precast Concrete Unit Paving in three (3) separate color ranges, at each of the listed shapes, complying with the following requirements:
 - 1. Refer to Contract Drawings
 - 2. Landscape Architect to make final decision / review based upon field constructed mock-ups.
- G. Styles:
 - 1. Style to match the referee sample, as acquired by the Landscape Architect.
- H. Textures: Finished Precast Concrete Unit Paving surfaces under this Article shall be "slip-resistant", per the requirements outlined in the ADAAG 4.5.1.
 - 1. Surface texture to match referee samples, as acquired by the Landscape Architect.
- I. Pattern(s): Pattern(s) of finished surface shall be in accordance to the layout as indicated in the Contract Drawings. Butt joint and maintain continuity of alignment that minimizes the need to sawcut the Precast Concrete Unit Paving Modules to satisfactorily fit to the designated pattern(s) within the designated areas.
- J. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:

1. Pavestone Company, Grapevine, TX. (Keystone Hardscapes, Inc.)
2. Wausau Tile (Textura Designs), Wausau, WI.
3. Or equal, as approved by the Landscape Architect.

2.2 GRADED AGGREGATE SUB-BASE MATERIAL

- A. Graded Aggregate Sub-base: Quality-controlled, graded aggregate.
1. Conform to ASTM D448 Gradation.
 2. Meet ASTM D2940.

2.3 SAND BEDDING MATERIALS

- A. Sand for Leveling/Bedding Course:
1. General: Sand for Leveling/Bedding Course shall be clean, washed, fine-textured, sharp (angular), neutral pH, no salinity, free from deleterious or foreign matter.
 - a. Conform to ASTM Requirements for Concrete Sand.
 2. Properties and Gradation: Conform to the grading requirements of ASTM C33 with modifications as follows:

Grading Requirements for Sand for Leveling/Bedding Course ASTM C33 Sieve Analysis	
Sieve Size	Percent (%) Passing
3/8"	100
No. 4	95-100
No. 8	85-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10
No. 200	0-1

3. Sieve accordingly per ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
4. Sand Bedding Material conforming to ASTM C144 (Mason's Sand) shall not be used.

2.4 JOINT FILLER MATERIALS

- A. Polymer-Modified (Polymeric) Finishing Sand for Paving Joints:
1. General: Polymer-Modified (Polymeric) Finishing Sand for Paving Joints shall be a high-performance, pre-packaged, clean, washed, fine-textured, sharp (angular), neutral pH, no salinity or deleterious materials (to avoid staining or efflorescence), resistant to insect and inhibits weed growth, with formulated bonding polymers.
 2. Properties and Gradation: Conform to the grading requirements of ASTM C144 with modifications as follows:

Grading Requirements for Finishing Sand for Paving Joints

ASTM C144 Sieve Analysis	
Sieve Size	Percent (%) Passing
No. 4	100
No. 8	95-100
No. 16	70-100
No. 30	40-100
No. 50	20-40
No. 100	10-25
No. 200	0-10

3. Sieve accordingly per ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
4. Color:
 - a. Final color selection of Joint Sand to be confirmed upon final color selection of Unit Paver Modules during Submittals.
5. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. HP Polymeric Sand for Pavement Joints, Techni-Seal.
 - b. Joint-Lock™ Sand, Package Pavement.
 - c. PowerLoc™ Jointing Sand, Quikrete Products,
 - d. Bonsal® Polymeric Joint Sand, Bonsal American.
 - e. Or equal, as approved by the Landscape Architect.

B. ACCESSORIES

- C. Geotextile Filter Fabric: Permeable, lightweight, continuous, non-woven, geo-textile polypropylene filament material, UV resistant, engineered to allow water permeability and deter soil permittivity per ASTM D4491. Geotextile Filter Fabric shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis and acids. Meet AASHTO M288-96, Class 1. Fabric shall have a permeability rating 10 times greater than that of soil on which paving is founded and an AOS (apparent opening size) small enough to prevent passage of fines from leveling course into graded aggregate of base course below.
1. Mirafi Ten-Cate – FW402 or approved Equal

2.5 UNIT PAVING SEALANT

- A. Penetrating Sealant:
1. General: Penetrating Sealant shall be an invisible, water-based Penetrating Sealant, used to protect exterior Unit Paving installations. Sealant shall be a clear, non-flammable, UV-stabilized, non-yellowing solution which cures to reduce staining, soiling, discoloration, efflorescence, and acts as an invisible water-repellant coating, formulated to impart water repellence and dirt reduction to Unit Paving surfaces with no change in the surface appearance. Sealant shall react with carbon dioxide, and atmospheric moisture to form a penetrating water, dirt and mildew repellent barrier within 24 hours.
 2. Moisture absorption rate shall be low to reduce visible surface changes for up to ten (10) years.
 3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. SLX100, Prosoco, Inc.

- b. Or equal, as approved by the Landscape Architect.
- 4. Provide sealer mock-up for final sealer approval on all colors of selected pavers prior to installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive Unit Paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Unit Paving. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Provide Cast-in-Place Concrete Edge Restraints as indicated on the Contract Drawings, under requirements of another Section. Install Edge Restraints prior to placing Unit Paving.
- C. Flatness Tolerance: Variation from true plane, or flat surfaces, shall be determined by use of a four-foot (4') long straightedge, applied in any direction on the surface. Such variations on polished, honed and fine rubbed surfaces at the bed and joint arris lines shall not exceed 3/64" or 1/16 of the specified joint, whichever is greater. On surfaces having other finishes, the maximum variation from true plane at the bed and joint arris lines shall not exceed 1/4 of the specified joint width.
- D. Variations from true plane on other parts of the face surfaces shall not exceed the following:
 - 1. Polished, honed or fine rubbed finishes: 3/64 in.
 - 2. Rubbed or fine stippled sandblasted finishes: 1/16 in.
 - 3. Shot ground, 8- and 6-cut finishes: 1/8 in.
 - 4. Thermal and coarse stippled sandblasted finishes: 3/16 in.
- E. Backs of pieces shall be sawn or roughly dressed to approximate true planes. Maximum variation in thickness from the specified shall not exceed the following:
 - 1. 1/4 in. on pieces up to modular 12 in. thick.
 - 2. 1/2 in. on pieces above 12 in. modular thick.

3.2 PREPARATION OF SOIL SUB-GRADE

- A. Proof-roll prepared sub grade surface to check for unstable areas and areas requiring additional Soil Sub-Grade: Proof-roll prepared soil sub-grade surface to check for unstable areas and areas requiring compaction to meet the following:
 - 1. Pedestrian Areas: Compact soil sub-grade uniformly to at least ninety-eight-percent (98%) Standard Proctor Density, per ASTM D698.
 - 2. Vehicular Use Areas: Compact soil sub-grade uniformly to at least ninety-eight-percent (98%) Modified Proctor Density, per ASTM D1557.
- B. Verify that sub-grade preparation, compacted density, and elevations conform to specified requirements.
- C. Provide written density test results for soil sub-grade to the Owner. Do not proceed with Work until deficient sub-grades have been corrected.

3.3 PREPARATION OF CONCRETE SUB-SLAB

- A. Refer to Section 32 1315 "Landscape Architectural Cement Concrete Paving" for concrete sub-slab installation and product requirements.
- B. Verify that sub-slab is free of cracking or other potential structural failures. If any, coordinate repair or replacement of affected areas or entire slab as needed to provide sound structural sub-slab.
 - 1. Provide required membrane setting over all sub-slab joints per details in contract documents.
- C. Clean sub-slab, after (7) seven days full cure, of all debris, oils, grease or dirt with water blast and mild solutions as needed.
- D. Remove any excess concrete over pours, burden or other obstructions that may interfere with pavers or sand setting base installation.

3.4 PREPARATION OF GRADED AGGREGATE SUB-BASE

- A. After acceptance of compacted soil Sub-grade, place Graded Aggregate Sub-base at required depth as indicated on the Contract Drawings. Set Graded Aggregate Sub-base in equal compacted layers, with each layer not exceeding four-inches (4") in thickness. Thickness of the layers shall also be consistent with the capabilities of the compaction equipment. Meet the following compaction densities:
 - 1. Pedestrian Areas: Compact Graded Aggregate Sub-base uniformly to minimum ninety-eight-percent (98%) Proctor Density, in accordance with ASTM D698.
 - 2. Vehicular Use Areas: Compact Graded Aggregate Sub-base uniformly to at least ninety-eight-percent (98%) Modified Proctor Density, per ASTM D1557.
- B. Tolerances: It is essential that the intended surface profile is formed by the Compacted Graded Aggregate Sub-base so the Unit Paving Modules can be placed on a uniform thickness of Bedding Sand. Meet the following:
- C. Sub-base surface tolerance should be +/- 3/8" over a 10'-0" straight edge.
- D. Verify that Graded Aggregate Sub-base materials, thickness, compacted density, surface tolerances, and elevations conform to specified requirements.
- E. Provide written density test results for Graded Aggregate Sub-base to the Owner. Do not proceed with Work until deficient Sub-base has been corrected.
- F. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

3.5 PREPARATION

- A. Verification of Base: Verify Sub-base is dry and accepted as meeting material, installation, and grade specifications.
- B. Install Edge Restraints/Headers in locations as indicated on the Contract Drawings at the indicated elevations and set per manufacturer's recommendations (as required).
- C. Geotextile Filter Fabric: Set Geotextile Filter Fabric onto the surface of the accepted Sub-base. Smooth out the Geotextile Filter Fabric, lapping the edges a minimum of 1'-0". Geotextile

Filter Fabric shall be placed so that the material entirely covers the Sub-base and extends up the side of the areas that contain the Setting Bed material. Do not allow construction equipment on the Geotextile Filter Fabric.

3.6 INSTALLATION OF LEVELING/BEDDING COURSE

- A. Spread Sand for Leveling/Bedding Course evenly over the Geotextile Filter Fabric and screed rails, using the rails and/or edge restraints to produce a uniform nominal thickness of one-inch (1"). The moisture content shall remain constant and the density is loose and constant until Unit Paving Modules are set and compacted.
 - 1. The Leveling/Bedding Course is not meant to and shall not be used to fill in low spots nor its thickness adjusted to bring the paving to the correct grade. Any changes in thickness or undulations in the Leveling/Bedding Course will reflect on the paving surface, and shall be subject to rejection by the Landscape Architect.
 - 2. Do not disturb screeded surface.
 - 3. Screeded areas shall not substantially exceed that which is covered by Unit Paving Modules in one (1) day's work.
 - 4. Do not use Sand for Leveling/Bedding Course to fill depressions in the base surface.

3.7 INSTALLATION OF UNIT PAVERS

- A. Do not use Unit Paving Modules with chips, cracks, spalled edges, voids, discolorations, and other defects that might be visible or cause staining in finished Work. Remove and replace defective or broken Units at the direction of the Landscape Architect. Units shall be clean and free of dirt and foreign matter on all sides, and shall be dry before setting.
- B. Mix Unit Paving Modules obtained from several different pallets or cubes as they are placed to produce uniform blend of colors and textures.
- C. Place Unit Paving in the desired pattern(s) as indicated in the Contract Drawings, laid with a 1/16" to 1/8" average joint width, being careful not to disturb Leveling/Bedding Course.
 - 1. If Unit Paving have integral-cast spacer bars, place Units hand tight against spacer bars. Fill gaps between Units that exceed 3/8-inch with pieces cut to fit from full-size Unit Pavers.
 - 2. Joint width shall not exceed 1/8".
- D. String lines or chalk lines to maintain the aligned pattern(s). Units shall be set true to the required lines and grades. Joints shall be uniform in thickness. Set whole Units first, followed by Units that are cut to size. Cut Units, when necessary, with motor-driven masonry saw equipment to provide an accurate, clean, straight, sharp cut, with un-chipped or spalled edges. Cut Units to provide pattern indicated and to fit adjoining work neatly. Use full Units without cutting, where possible.
 - 1. Hammer cutting is not acceptable.
 - 2. For Precast Concrete Unit Paving Modules, a block splitter may be used.
- E. Joint Pattern(s): Patterns as indicated on the Contract Drawings.
- F. Tolerances: See Pavement Tolerances Article indicated herein this Section.
- G. Where Unit Paving Modules meet the sides of edge restraints, or where special patterns are delineated in the overall layout plan, the Unit Paving Modules that meet the edges of these

conditions shall be of whole units to the greatest extent possible. Units that are required to be cut or split to complete the layout composition shall not be smaller than $\frac{3}{4}$ the size of the smallest unit. Contractor shall be responsible to field-adjust the pattern of the Unit Paving Modules accordingly, per the direction of the Landscape Architect.

- H. Keep heavy equipment off newly laid Unit Paving Modules that have not received initial compaction and sanded joints.
- I. Once set, vibrate Unit Paving Modules into Leveling/Bedding Course with a low-amplitude plate vibrator capable of at least 5000-lbf compaction force at a frequency of 75 to 100 Hhz to vibrate the Unit Paving Modules into the Leveling/Bedding Course. Perform at least three (3) passes across the surface with the plate vibrator. Remove any cracked or damaged Unit Paving Modules and replace with new Units. Vibrate under the following conditions:
 - 1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
 - 2. Before ending each day's Work, fully compact installed Unit Paving within thirty-six-inches (36") of the laying face. Cover the open layers with non-staining plastic sheets overlapped 48-inches on each side of the laying face to protect from rain.

3.8 APPLICATION OF SANDED JOINTS

- A. General:
 - 1. Follow manufacturer's directions for installation.
 - 2. Prior to installation of Pre-Packaged Polymer-Modified (Polymeric) Joint Sand, the surface must be completely dry and the joints are free of dirt and debris. Any moisture that is evident on the surface will commence a premature bonding reaction of the polymers in the Joint Sand material.
 - 3. Do not install if rain is forecasted.
- B. Placement of Pre-Packaged Polymer-Modified (Polymeric) Joint Sand:
 - 1. Spread Pre-Packaged Polymer-Modified (Polymeric) Joint Sand material over paved surfaces evenly and into joints between Unit Paving immediately after vibrating Unit Paving Modules into leveling course. Completely cover Unit Paving surface with thin layer, using push broom. Sweep the material into the joints with a slight pounding motion.
 - 2. Once a substantial area of the surface has been swept, vibrate the Unit Paving surface with the plate compactor in overlapping passes. Continue procedure until all of the joints are completely full and joint sand material can no longer be swept or vibrated into the joints. Do not compact within six-feet (6') of an unrestrained edge.
- C. Activation of Bonding:
 - 1. Prior to activation of Bonding, carefully sweep entire Unit Paving area clean to remove excess Joint Sand material from the surface. Excess Joint Sand material, including chamfered areas, must be swept-off the paved surface and removed. Power broom or blowers are recommended for large areas.
 - 2. The paving area, including the joints, shall be moistened with a wide, light spray, in a continuous manner, allowing water to gently flow into the Unit Paving joints. For optimal results, wetting the surfaces shall take place in sections of 500 square-feet at a time. Ensure that the wetting of one (1) section is finished before wetting of another

section. Care shall be exercised to avoid flooding the surface and causing a runoff, or displacing the Joint Sand from the joints. Do not use high pressure sprayers for flooding surfaces. Repeat water application 2-3 times at ten (10) minute intervals. Once the joints are moistened to their full depth, stop watering that section and move to the next section. Too much water will cause the polymer binders to run-off and prevent the sand from solidifying.

- 3.
4. To insure optimal cohesion and long-term stability, the area shall be allowed to become completely dry and free from traffic before being exposed to water. Drying time will be prolonged in cold and damp weather and can be considerably less in dry climates. Protect the area from traffic until activation has occurred.

3.9 PAVEMENT TOLERANCES

- A. The maximum variation from plane of the pavement surface shall be +/- 3/8" in 10'-0". The edges of any two adjacent Unit Paving Modules shall not differ by more than 1/16" in height.
- B. Unit Paving Modules adjacent to drainage inlets and channels shall not be lower than the top of the drain, and not more than 3/16" above it.

3.10 APPLICATION OF UNIT PAVING SEALANT

- A. Penetrating Sealant:
 1. Following installation of Unit Paving, apply Sealant to exposed Unit Paving surfaces with two (2) coats of the Penetrating Sealant. Apply in accordance with Manufacturer's written directions. Finished surfaces shall be uniform in appearance and not mottled.

3.11 REPAIR, CLEANING, AND PROTECTION

- A. Remove and replace Unit Paving materials that are loose, chipped, broken, stained, or otherwise damaged or if Units do not match adjoining units as intended. Provide new Units to match adjoining Units and install in same manner as original Units, with same joint treatment to eliminate evidence of replacement.
- B. Provide final protection and maintain conditions in a manner that insures that Work is without damage or deterioration at the time of Substantial Completion.
- C. Maintain finished surfaces free of stains, discoloration, dirt, and other foreign material until Final Acceptance of Work.

END OF SECTION

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Posts, rails, and frames.
- B. Wire fabric.
- C. Shade cloth/privacy scrim.
- D. Excavation for post bases; concrete foundations for posts.
- E. Manual gates with related hardware.
- F. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - CAST-IN-PLACE CONCRETE: Concrete anchorage for posts.
- B. Section 33 79 00 - SITE GROUNDING.
- C. Section 08 71 XX - Area Development Finish Hardware.

1.03 REFERENCE STANDARDS

- A. General: Refer to most recent edition or edition adopted by authorities having jurisdiction, including all applicable amendments and supplements.
- B. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- E. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
- F. ASTM A428/A428M - Standard Test Method for Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles.
- G. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- J. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
- K. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
- L. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.

- M. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework.
- N. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
- O. ASTM F1665 - Standard Specification for Poly(Vinyl Chloride)(PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence.
- P. CLFMI CLF-PM0610 - Product Manual.
- Q. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric).
- R. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- S. CLFMI CLF 2445 - Product Manual - Drawings.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on C.L. fabric, posts, accessories, fittings, Screen Fabric, and hardware.
- C. Shop Drawings: Plans, elevations, sections, and details, including fully dimensioned actual layout of components and accessories. Indicate dimensions, clearances required, materials, finishes, and anchorage to or in supporting construction.
- D. Samples: Submit two samples of C.L. fence materials, and all fence components, including Visual Screen Fabric for material color, gauge, and finish.
- E. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation anchor bolt templates, and screen installation.
- F. Unless specific colors, textures, and/or finishes are indicated on Drawings, submit accurately representative samples of all colors, textures, and/or finishes, as applicable, for selection by Owner.
- G. Project Record Documents: Accurately record actual locations of all fence posts and gate locations.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 PROJECT CONDITIONS

- A. Protection: Protect completed installation from damage of subsequent construction activities. Immediately remove any foreign matter that accumulates on exposed, finished surfaces in accord with manufacturer's recommendations.
- B. Sequencing and scheduling:
 - 1. Coordinate and sequence erection or installation of work of this Section with adjacent or integral materials, products, and work specified in other Sections. Such work includes, but is not limited to, the following:
 - a. Grading.

- b. Asphalt concrete paving.
 - c. Concrete paving, including curbs.
- 2. Order specified materials, products, and similar items with extended "long lead" (ordering) times, sufficiently in advance of scheduled installation, or erection dates to permit any required shop or field alteration, modification, or finishing and to not delay the scheduled progress of the Work. Such items include, but are not limited to, the following:
 - a. Items of rare ("short") supply.
 - b. Items of nonstandard or custom fabrication.
 - c. Items with nonstandard, optional or custom finishes.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chain Link Fences and Gates:
 - 1. Master-Halco, Inc.: www.masterhalco.com.
 - 2. Merchants Metals: www.merchantsmetals.com.
 - 3. Substitutions: See Section 01 60 00 - PRODUCT REQUIREMENTS.

2.02 COMPONENTS

- A. Line Posts: 1.9 inch (48 mm) diameter.
- B. Corner and Terminal Posts: 2.38 inch (60 mm) diameter.
- C. Fabric with Pre-Inserted Slats: 2 inch (51 mm) diamond mesh interwoven wire, 6 gage, 0.1920 inch (4.9 mm) thick, top selvage knuckle end closed, bottom selvage twisted tight.
 - 1. Privacy Slats: High-density polyethylene (HDPE), woven into fabric.

2.03 MATERIALS AND COMPONENTS

- A. Materials and Components: Conform to CLFMI CLF 2445.
- B. Fabric Size: CLFMI CLF 2445 Heavy Industrial service.
- C. Intermediate Posts: Type I round.
- D. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.
- E. Gates: _____.

2.04 MATERIALS

- A. Posts, Rails, and Frames:
 - 1. Group 1A: ASTM F 1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction, minimum yield strength of 25 ksi. Schedule 40, electric welded seamless pipe with external and internal hot-dip zinc coating of 1.8 oz. per sq. ft.
 - 2. Group 1C: Formed from hot-dipped galvanized steel sheet, ASTM A653/A653M, HSLAS Type A, Grade 50, with G90 (Z275) zinc coating. Grade 50, Class 1 or 2 (ASTM A446, Grade D) or ASTM A569 with minimum yield strength of 50,000 psi, cold-rolled and

electrically-welded, with external and internal protective coatings conforming to ASTM F1234 as follows:

- a. External: Type A (1.8 oz. per sq. ft., minimum average, hot-dip zinc coating), or Type B (0.9 oz. per sq. ft., minimum zinc coating with chromate conversion coating and minimum 0.3 mils acrylic/polymer coating).
 - b. Internal: Type B (0.9 oz. per sq. ft. minimum, zinc coating with chromate conversion coating or Type D (zinc-rich organic coating with minimum 90% zinc powder).
 3. Line Posts: Type I round in accordance with FS RR-F-191/1D
 4. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.
 5. Conform to CLFMI CLF-PM0610.
- B. Wire Fabric:
1. Galvanized: Class 1, 11 gauge wire, woven into approximately 2 in. mesh, and provided with hot-dip galvanized finish before or after weaving; completely free of barbs, icicles, or other projections which might be hazardous.
 2. Vinyl-coated: ASTM A641, Class 1, 11 gauge core wire with galvanized finish and fusion bonded polyvinyl chloride (PVC) coating conforming to ASTM F668, Class 2a or 2b, woven into approximately 2 in. mesh; completely free of voids, tears, cuts and similar defects that reveal wire substrate. Colors of PVC coating shall be as selected by Owner and are not limited to standard colors specified in ASTM F934.
 3. Knuckle top and bottom selvage.
 4. ASTM A392 zinc coated steel chain link fabric.
 5. Conform to CLFMI CLF-PM0610.
- C. Concrete:
1. Type specified in Section 03 30 00.
- D. Pipe Size and weight as follows: Min. wt. per foot.

Item	Nominal Pipe Size	Outside Diameter	Group 1A	Group 1C
Top rail, brace rails and transom rails	1-1/4	1.660 in.	2.27 lb.	1.82 lb.
Gate frames:				
Up to 6 ft. high	1-1/2	1.900 in.	2.72 lb.	2.28 lb.
Up to 6 ft. high	2	2.375 in.	3.65 lb.	3.12 lb.
Line posts:				
Up to 6 ft. high	2	2.375 in.	3.65 lb.	3.12 lb.
More than 6 ft. high	2-1/2	2.875 in.	5.79 lb.	4.64 lb.
Terminal, corner, angle, and pull posts:				

Item	Nominal Pipe Size	Outside Diameter	Group 1A	Group 1C
Up to 6 ft. high	2-1/2	2.875 in.	5.79 lb.	4.64 lb.
More than 6 ft. high	3	3.500 in.	7.58 lb.	5.71 lb.
Swing gate posts:				
Up to 6 ft. wide	2-1/2	2.875 in.	5.79 lb.	4.64 lb.
Up to 12 ft. wide	3-1/2	4.000 in.	9.11 lb.	6.56 lb.
Up to 18 ft. wide	6	6.625 in.	18.97 lb.	
Up to 24 ft. wide	8	8.625 in.	28.55 lb.	
Slide gate posts (cantilever):				
Up to 12 ft. wide	2-1/2	2.875 in.	5.79 lb.	4.64 lb.
More than 12 ft. wide	3-1/2	4.000 in.	9.11 lb.	6.56 lb.

2.05 COMPONENTS

- A. Tension Wire: 6 gage, 0.1920 inch (4.9 mm) thick steel, single strand.
- B. Tension Strap: ____ inch (____ mm) thick steel.
- C. Tie Wire: Aluminum alloy steel wire.

2.06 MANUAL GATES AND RELATED HARDWARE

- A. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1,525 mm) high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.
- B. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1,525 mm) high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

2.07 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
- C. Extension Arms: Cast steel galvanized, to accommodate 3 strands of barbed wire, single arm, vertical.

- D. Concrete and grout materials: In accord with Sections 02705, 03300, and 03301.
- E. Barbed wire: Two-strand, galvanized, 12-1/2 gauge line wire with 14 gauge, four-point round barbs spaced approximately 5 in. o.c. in accord with ASTM A121, Chain Link Fence Grade (Class 3 zinc coating).
- F. Barbed tape (at fences minimum 8 ft. height): Manufactured from Type 430 stainless steel strip, minimum 0.025 in. thick, with needle sharp, razor-edge barbs at 4 in. o.c., cold-clenched around a 0.098 in. minimum stainless steel wire core. Coil size and type (helical, concertina, single, double) shall be as selected by Owner. Provide manufacturer's standard stainless steel clips and tie wire.
- G. Visual screening: Closed mesh (approximately 90% obscure) shade cloth/privacy screening with reinforced edges and grommets every 18 inches on perimeter of each panel.
 - 1. Screens shall be NFPA 701 Compliant.
 - 2. Screens shall provide minimum 95% UV blocking if providing shade to cast members.
 - 3. Color: As selected by Owner from standard colors.
 - 4. Screen suitable for non-temporary installations: Polytex Comtex Fire Rated Kintted Shade Fabric; 10-year warranty; wide range of standard colors.
 - 5. Pre-approved manufacturers:
 - a. Wind & Shade Screens, San Marcos, CA, Contact: Paul Leathem; Tel: (800) 423-6996; (760)761-4994; windandshadescreen.wixsite.com/screen.
 - b. Astrup, Santa Fe Springs, CA, Tel: (562) 921-8884, (800) 786-7604.
- H. Isolation tape: Polymer alloy film with elastomeric coating, 30 mils thick, specifically designed for corrosion and electrolytic protection of embedded metals, Tapecoat H30 by The Tapecoat Company, Evanston, IL, Tel: (708) 866-8500, 3602 Corrosion Inhibiting Tapewrap by Rust-Oleum Corp., Vernon Hills, IL, Tel: (708) 367-7700, or Owner-approved equivalent.]

2.08 FINISHES

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot (530 g/sq m).
- B. Components (Other than Fabric): Aluminum coated at 0.40 ounces per square foot (120 g/sq m), when measured in accordance with ASTM A428/A428M.
- C. Components and Fabric: Vinyl coating, black color as selected over coating of 1.8 oz/sq ft (550 g/sq m) galvanizing.
- D. Vinyl Components: Black color as selected and approved by owner. When indicated for Vinyl finish, all components to be Vinyl clad.
- E. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- F. Accessories: Same finish as framing.

2.09 HARDWARE

- A. Provide hinges, bolts, cane bolts (with steel pipe sleeve and precast concrete collar where applicable), fork latches, keepers, and other operating hardware of manufacturer's standard as approved by Owner.

B. Pedestrian emergency exit gates:

1. Exit device: Weather-resistant, non-alarm type with outside keyed cylinder entry, Detex ECL-8010W, silver-gray finish; provide without alarm device components including inside (secure side) control cylinder mechanism.
 - a. Cylinder: 6-pin interchangeable core rim type, Schlage 20-057 x 626 (no substitutions).
2. Closer: Adjustable, torsional-type gate spring.
3. Monitoring switch: Weather-resistant, industrial type, wide gap magnetic contact switch with stainless steel armored cable, Sentrol 2507-A. Provide with chain link fence brackets, Sentrol 1941 and 1942, hot-dip galvanized finish. Provide spacers, brackets, wire clamps, fasteners and other accessory materials as required.

C. Padlocks: 6-pin interchangeable core, Schlage PL4003 x 452 (no substitutions).]

2.10 FABRICATION - WELDING

- A. Gate frames: Miter and continuously weld at corners and intersections of intermediate brace rails.
- B. Posts: Continuously weld angle top posts at angle/vertical intersections and at continuous top rail connections.
- C. Continuously weld, without voids, around entire part interface, at other conditions.
- D. Welds exhibiting uniformity and soundness may remain as drawn. All other welds shall be ground smooth.
- E. Hot-dip galvanize welded assemblies after completion of fabrication.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- D. Line Post Footing Depth Below Finish Grade: ASTM F 567.
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F 567.
- F. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
- G. Provide top rail through line post tops and splice with 6 inch (150 mm) long rail sleeves.
- H. Install center brace rail on corner gate leaves.
- I. Do not stretch fabric until concrete foundation has cured 28 days.
- J. Stretch fabric between terminal posts or at intervals of 100 feet (30 m) maximum, whichever is less.

- K. Position bottom of fabric 2 inches (50 mm) above finished grade.
- L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches (380 mm) on centers.
- M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- N. Do not attach the hinged side of gate to building wall; provide gate posts.
- O. Install hardware and gate with fabric to match fence.
- P. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
- Q. Ground fence in accordance with Section 33 79 00.
- R. Install gate locking device.

3.02 VISUAL SCREENING

- A. Fabricate in sections with minimal, horizontal seams, in longest lengths possible and practical with hemmed edges and non-corrosive grommets (at not greater than 24 inches on center); provide additional grommets (in reinforced seams) at intermediate locations coincident with horizontal brace rails, at fence heights greater than 10 feet. All horizontal seaming shall be identical, consistently located on all sections, and wherever practical, coincident with framework members.
- B. Secure to fencing fabric at grommet locations only using tie wires or clips as specified for fencing fabric attachment and/or polyester/polypropylene cording. Method of attachment must be adjustable at all times. Visual screening shall be taut and flat and exhibit even tension throughout; ripples, and similar visually unacceptable appearances are not permitted at any time.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm).
- B. Maximum Offset From True Position: 1 inch (25 mm).
- C. Do not infringe on adjacent property lines.

END OF SECTION

SECTION 323300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Site and Street Furnishing installations, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing or installing the following:
 - 1. Planters and Pots
 - 2. Bollards
 - 3. Trash and Recycle Receptacles
 - 4. Pet Waste Receptacles
 - 5. Outdoor Charging Stations and Media Outlets
 - 6. Outdoor Grill and Kitchen Systems
 - 7. Chaise Lounges
- C. Related Documents: The following Documents contain requirements of Work that relate to this Section:
 - 1. Section 05 50 13 "Site Miscellaneous Metal Fabrication".
 - 2. Section 32 13 13 "Landscape Architectural Cement Concrete Paving".
 - 3. Section 32 13 23 "Cast-In-Place Concrete for Landscape Elements".
 - 4. Section 32 14 00 "Unit Paving Systems".

1.2 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.

- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Product Data: Submit manufacturer's current literature for the following items:
 - 1. Color, finish and size for each type of furnishing.
 - 2. Installation instructions and recommendations for general maintenance.
 - 3. Color chips using same material as the manufactured product showing texture, color and configuration.
- H. Samples:
 - 1. Each Product Specified: Photo or actual sample if locally available. (100 miles driving from jobsite or landscape architect's office)
 - 2. Material Color Chips and Samples: Required for each furnishing. Chip to be constructed using same material as the manufactured product and shall illustrate texture, color and configuration.
- I. Shop Drawings: Installation and anchorage details for all manufactured items.
 - 1. Items:
 - a. Benches
 - b. Bollards
 - c. Trash and Recycle Receptacles
 - 2. Show plans, elevations, with dimensions, details of inserts, and reinforcements, setting methods, shims dowels or anchorage needed to install the item and comply with details on the drawings.
 - 3. Provide detail and dimensioned drainage and irrigation access details for pots. Shop drawing to be coordinated with pot interior and paving exterior to illustrate necessary construction coordination for drainage and irrigation.
- J. Submittal Schedule: All products in this section which is required for submittal shall be included in one landscape submittal package which includes all associated items required to complete the furnishing(s) installation.

1.3 QUALITY ASSURANCE AND CONTROL

- A. All materials and Work shall be in accordance with the State Codes and Specifications and other criteria herein specified.
- B. Single-Source Responsibility: Obtain furnishing Units from each respective single source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
- C. Substitutions: Unit(s) to be considered equal to those specified herein this Section shall be reviewed and approved by the Landscape Architect, in writing, prior to the Bid Date. No substitutions shall be allowed after the Bid Date.

1.4 COORDINATION

- A. Contractor shall coordinate the installation of all furnishings in this Section with all other related Work of this Contract.
- B. Contractor shall be responsible for verifying the dimensions and required hardware of the furnishings prior to commencing installation Work.
- C. Coordinating furnishing footings with utility locations. Note potential conflicts to the Landscape Architect.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Labeling: Furnish all materials in manufacturer's unopened, original containers, bearing original labels showing quantity, description and name of manufacturer.
- B. Delivery: Deliver and unload at the site on pallets and bound in such a manner that no damage occurs to the product.
- C. Storage: Store products in a manner which will preclude all damages. Damaged materials will be rejected. Remove all damaged materials from the job site immediately, and replace at no cost to Owner.
- D. Handling: Furnish suitable equipment to locate all site furnishing materials carefully and efficiently. Lift materials using lifting inserts provided by manufacturer where applicable.

PART 2 - PRODUCTS

- 2.1 Manufacturers: Refer to drawings. Alternate manufactures if requested by contractor will be required to meet or exceed the selected manufactures finish design including shape and size, color and material in every way for consideration.

- 2.2 CONDITION: All products are to be new and in first class condition.

2.3 WARRANTY

- A. Manufacturer's Warranty: Contractor shall arrange manufacturer's warranty to the effect that all manufactured products shall carry a minimum one year manufactures warranty which shall be transferred to the owner at time of acceptance. The warranty period shall commence on the date of acceptance of the installation. Early delivery shall not limit the installed warranty period.
- B. Contractors Warranty: Contractor shall warrant all workmanship in addition to the manufacturer's warranty for a period of one year from the date of acceptance.

- 2.4 CONCRETE FOOTINGS: Reference details in Contract Documents for requirements or manufacturers requirements or recommendations.

2.5 ANCHORS

- A. Non-corrosive, stainless or galvanized as approved. Embed in epoxy grout or provide expansion anchors.

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.
- B. Acceptance: Area will be accepted when furnishings are permanently installed in accepted positions.
- C. Locations: Layout each item for approval in the general location as shown on the Drawings. Review with the Owner's Representative or Landscape Architect to confirm exact installation locations prior to final installation.
- D. Special Precautions: Guard against staining or damaging of existing pavements and plantings where site furnishings are to be installed.
- E. Paint exposed installation hardware to match furnishing color.
- F. Shim all furnishings to level.
- G. Acceptance: Do not install site and street furnishings prior to acceptance by Landscape Architect of area to receive such materials.
- H. Special Precautions: Guard against staining or damaging of existing pavements and plantings where site furnishings are to be installed.

3.2 CONCRETE PADS AND FOOTINGS

- A. Layout: Accurately layout all pads and footings as called for in the Drawings.
- B. Installation: Excavate and form as required and fill for pads and footings as specified in 32 13 23 "Cast-In-Place Concrete for landscape Features".

3.3 BOLLARDS:

- A. Place and anchor per manufacturer's requirements in approved locations/alignment.
- B. Protect in place until work is accepted.
- C. Clean.

3.4 BENCHES:

- A. Place and anchor per manufacturer's requirements in approved locations/alignment.
- B. Make connections to electrical and gas plumbing per other specifications sections and manufacturer.

- C. Install accessory handles.
- D. Protect in place until work is accepted.
- E. Clean.

3.5 TRASH AND RECYCLE RECEPTACLES:

- A. Place and anchor per manufacturer's requirements in approved locations/alignment.
- B. Protect in place until work is accepted.
- C. Clean.

3.6 REPLACEMENTS

- A. Replace all products, materials and workmanship found to be defective through the end of the warranty period.

3.7 TOUCH-UP

- A. Provide Owner with manufactures touch-up paint (1-pint minimum) for each painted furnishing. Supply literature necessary for ordering touch-up paint at a later date.

3.8 DEMONSTRATION

- A. Demonstrate the operation and maintenance of all equipment to the Owner. Submit final copy of all maintenance manuals at the time of demonstration.

3.9 PROTECTION

- A. Maintain locked lids until acceptance by Landscape Architect. Replace all missing accessories at no cost to Owner.
- B. Wrappings: Do not remove protective wrappings from furnishings until instructed by Landscape Architect.
- C. Provide additional protection, coverings or barricades to insure work is not damaged and repair or replace damaged goods at no additional cost to the owner.

3.10 CLEAN UP

- A. Keep all areas of work clean, neat and orderly at all times.
- B. Clean up and remove all stains, packing and debris from the entire work or on any furnishing area prior to Final Acceptance.

END OF SECTION

SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete and thorough preparation of the planting soil, including soil amendment products, imported topsoil, as required, to make up deficiencies in quantity of soil available on site, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Agronomic Soil Fertility Testing and Soil Percolation Testing.
 - 2. Topsoil.
 - 3. Pre-Plant Weed Control.
 - 4. Soil Conditioners, Amendments, and Fertilizers.
 - 5. Import soil for specific plant material types and related requirements.
 - 6. Mixing of planting mediums
 - 7. Transporting and storage of soils and planting mediums.
 - 8. Machinery and loading restrictions.
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 31 2219 "Landscape and Fine Grading".
 - 3. Section 32 9200 "Lawns and Grasses".
 - 4. Section 32 9300 "Trees, Shrubs, Vines and Groundcovers".
 - 5. Section 32 9813 "Landscape Establishment Period".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. USDA – United States Department of Agriculture.
 - 2. ASTM – American Society for Testing and Materials.
- B. Definitions:
 - 1. Topsoil:

- a. Topsoil - Shall be friable soil, providing sufficient structure in order to give good till and aeration.
- b. Gradation Limits - Soil shall be a sandy loam, loam, clay loam or clay. The definition of soil texture shall be per the USDA classification scheme. Gravel over ¼-inch in diameter shall be less than 10% by weight.
- c. Permeability Rate - Hydraulic conductivity rate shall be not less than one-inch (1") per hour, nor more than twenty-inches (20") per hour, then tested in accordance with the USDA Handbook Number 60, Method 34b, or other approved Methods.
- d. Fertility - The range of the essential elemental concentration in soil shall be as follows:

Ammonium Bicarbonate/ DTPA Extraction (PPM):	
Element	(mg/kilogram) dry weight basis
Phosphorous	4 - 40
Potassium	60 - 220
Iron	4 - 35
Manganese	0.6 - 6
Zinc	0.6 - 8
Copper	0.1 - 5
Boron	0.2 - 1
Magnesium	50 - 500
Sodium	0 - 100
Sulfur	25 - 500
Molybdenum	.1 - 30

- e. Acidity - The soil pH range measured in the saturation extract (Method 21a, USDA Handbook number 60) shall be 6.0 – 7.9.
- f. Salinity - The salinity range measured in the saturation extract (Method 3a, USDA Hand Number 60) shall be 0.5 – 2.0 dS/m. If calcium and if sulfate ions both exceed 20 milli-equivalents per liter in the saturation extract, the maximum salinity shall be 4/0 dS/m.
- g. Boron - The maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1 mg/1 (parts per million).
- h. Sodium Adsorption Ratio (SAR) - The maximum SAR shall be 4 measured per Method 20b, USDA Handbook Number 60.
- i. Soil Organic Matter Content - Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter.
- j. Calcium Carbonate Content - Free calcium carbonate (limestone) may be present.
- k. Heavy Metals - The maximum permissible elemental concentration in the soil shall not exceed the following:

Ammonium Bicarbonate/DTPA Extraction (PPM):	
Element	(mg/kilogram) dry weight basis

Arsenic	
Cadmium	2
Chromium	10
Cobalt	2
Lead	30
Mercury	1
Nickel	5
Selenium	3
Silver	.5
Vanadium	3

- l. Elemental Concentration - If the soil pH is between 6 and 7, the maximum permissible elemental concentration shall be reduced 50%. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be present at 50% or more of the above values.
- m. Phytotoxic constituent, herbicides, hydrocarbons, etc. – Germination and growth of plants shall not be restricted more than 10% compared to standard controls. Standard controls shall be both monocots and dicots. Petroleum hydrocarbons shall not be present.
- n. Sub Grade - Soil level resulting from the rough grading work under another Section. Cultivation of sub grade areas prior to placement of Topsoil is included in this Section.
- o. Stockpiled Topsoil - Soil stockpiled for spreading over prepared sub-grade.
- p. Stockpiled Native Topsoil: Topsoil stripped from the site prior to rough grading Work (under another Section), to be spread and amended as Work under this Section.
- q. Imported Topsoil: Off-site Topsoil, imported and stockpiled under this Section, to be spread and amended as Work under this Section.

C. Measurements:

- 1. PPM: Measurement, in parts per million.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C.
- D. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific

identification methods) and legible information on the following information indicated in this Article.

- E. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- F. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- G. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- H. Product Data and physical Product Samples: Submit Manufacturer's current catalog cuts, specifications, and physical Product Samples provided in re-sealable labeled plastic bags (min. one (1) gallon size) for the following (as applicable):
 - 1. Planting Soil (Imported/Amended Topsoil).
 - 2. Soil Amendments (for each type used)
 - 3. Bulk Composted Organic Soil Amendment Material.
 - 4. Granular Soil Conditioning Material.
 - 5. Fertilizers (for each type used).
 - 6. Mycorrhizal Additives (granular or tabular).
- I. Approved Testing Laboratory and Procedures for Agronomic Soil Fertility Analyses:
 - 1. Agronomic Soil Fertility Analyses shall be conducted by a reputable, certified, agronomic soils laboratory. Laboratory shall be a member of the Council on Soil Testing and Plant Analysis. The same laboratory shall be used throughout the duration of the Contract:
 - a. Wallace Laboratories, El Segundo, CA. 310-615-0116.
 - 2. Contractor shall verify and confirm the selected Testing Laboratory and specific location(s) of soil sample(s) with the Landscape Architect prior to commencing soil sampling operations.
 - 3. Submit the physical Samples directly to the selected Laboratory for analysis, per the procedures outlined per Part III herein this Section.
 - a. In addition to the physical Soil Samples, Contractor shall also provide the Laboratory with a copy of the Soil Amendment and Fertilizer products indicated herein this Section.
 - b. Same samples (duplicates) shall be provided to SWA in 1-gallon samples
 - 4. Along with the testing data results, the Agronomic Soil Fertility Analysis shall include written recommendations by the Laboratory for amending and/or correcting the sampled soil conditions, utilizing the organic-based Soil Amendments and Fertilizers described herein this Section.
 - a. The Analyses shall also include Maintenance and Post-Maintenance fertilization programs for planted areas within the Contract.

5. Agronomic Soil Fertility Analyses shall be performed on each of the native site soil samples, the imported topsoil (as required) and lightweight soil mix (as required).
- J. Submit bound copies of the laboratory's Agronomic Soil Fertility Analysis and Recommendations to Landscape Architect a minimum of 45 days prior to amending of the soil and ordering soil amendments. The locations of where each of the soil test samples were derived from the Project Site shall be keyed to the site plan and shall be included with the results.
- K. Planting operations shall not commence until the results of the Agronomic Soil Fertility Analysis and Recommendations are reviewed accordingly by the Landscape Architect.
 1. The quantity or type of amendments may be modified by the Agronomic Soil Fertility Analysis and Recommendations. Recommendations as approved shall take precedence over the amendment and fertilizer application rates specified herein or on the Contract Documents.

1.4 QUALITY ASSURANCE AND CONTROL

- A. Certificates of inspection: Provide those required by law for transportation, with invoice. File copies of certificates with Landscape Architect after acceptance of material. Inspection by governmental officials at point of origin does not preclude rejection of materials at project site.
- B. Intent: The amendments and quantities included herein are approximate and are for bidding purposes only. Following an on-site soil analysis by the Wallace Labs, El Segundo, California, 310-615-0116, composition of amendments may change. Contract price shall be adjusted accordingly.
- C. All testing noted herein shall be paid for by Contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened packages or containers, with manufacturer's labels intact and legible, showing weight, analysis, and name of manufacturer. Store and secure properly to prevent theft or damage.
- B. Store packaged materials off ground and under cover, away from damp surfaces and inclement weather.
- C. Deliver and install materials so as to not delay Work, and install only after preparations for installation have been completed.
- D. Protect materials during storage and construction against soilage or contamination from earth and other materials.
- E.

F.

1.6 COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- C. Excavation: When conditions detrimental to adequate Soil Preparation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- D. Installation: Perform Soil Preparation operations only when weather and soil conditions are suitable in accordance with locally accepted practices.
- E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

1.7 PROJECT/SITE CONDITIONS

- A. Project Site shall be free of weeds and invasive grasses, (Nut Grass, etc.) prior to Topsoil distribution or soil amendment placement.
- B. Excessive rock, dead or declining vegetation, trash, debris, or other items that has accumulated throughout the duration of the Project shall be removed from the Project Site by the Contractor, and as directed by the Landscape Architect.
- C. Grading and soil preparation Work shall be performed only during the period when beneficial and optimum horticultural results may be obtained. If the moisture content of the soil should reach such a level that working it would destroy soil structure or cause compaction, spreading and grading operations shall be suspended until, in the opinion of the Landscape Architect, the moisture content is increased or reduced to acceptable levels and the desired results are likely to be obtained.

1. Soil moisture level prior to planting shall be no less than 75% of field capacity. The determination of adequate soil moisture for planting shall be in the sole judgment of the Landscape Architect.
 2. If the soil moisture level is found to be insufficient for planting, planting pits shall be filled with water and allowed to drain before commencing planting operations.
 - 3.
 - 4.
 - 5.
 - 6.
- D. Planting areas which become compacted in excess of 85% relative compaction due to construction activities shall be tilled and thoroughly cross-ripped to a minimum depth of twelve-inches (12") to alleviate the condition, taking care to avoid all existing subsurface utilities, drainage, etc.

1.8 BIDDING

- A. The amendments, quantities and procedures included herein are for bidding purposes only. Following an on-site agricultural soil analysis after the rough grading, the amendments and quantity and procedures may change.
- B. Tests shall be paid for by the Contractor.

1.9 FINAL ACCEPTANCE

- A. Acceptance: The Landscape Architect will accept the Work upon satisfactory completion of all soil preparation.
- B. Notification: Notify Landscape Architect for review of soil preparation prior to proceeding with planting operations.

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. Definition: Topsoil shall be defined as an onsite soil material that could be used in the planting mixes for backfill of tree, shrub and groundcover planting pits provided it can be made to conform to the provisions included under the title "Topsoil".
- B. General Qualifications: Topsoil shall be fertile, friable, well-drained soil, of uniform quality, free of stones over 1-inch diameter, sticks, oils, chemicals, asphalt materials and residues, toxic substances, concrete and other deleterious materials, as a planting medium for the project. It shall not be infested with nematodes or other undesirable disease-causing organisms such as insects and plant pathogens.

- C. Topsoil shall be friable and have sufficient structure in order to give good tilth and aeration to the soil. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
- D. Gradation limits
1. Soil shall be a sandy loam, loam, clay loam or clay. The material shall be as specified within these specifications or if not specifically identified it shall be similar to the existing site soil.
 2. The definition of soil texture shall be the USDA classification scheme.
 3. Gravel over ¼-inch in diameter shall be less than 10% by weight.
 4. 100 % of the material shall pass a 1" sieve.
- E. Permeability Rate - Hydraulic conductivity rate shall be not less than one inch per hour nor more than 20 inches per hour when tested in accordance with the USDA Handbook Number 60, method 34b or other approved methods.

- F. Fertility - The range of the essential elemental concentration in soil shall be as follows:

Ammonium Bicarbonate/DTPA Extraction	Parts per million (mg/kilogram) Dry Weight Basis
phosphorus	2 - 40
potassium	40 - 220
iron	2 - 35
manganese	0.3 - 6
zinc	0.6 - 8
copper	0.1 - 5
boron	0.2 - 1
magnesium	50 - 150
sodium	0 - 100
sulfur	25 - 500
molybdenum	0.1 - 30

- G. Chemistry - Suitability Considerations:
1. Acidity - The soil pH range measured in the saturation extract (Method 21a, USDA Handbook Number 60) shall be 6.0 - 7.9.
 2. Salinity - The salinity range measured in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 0.5 - 2.0 dS/m. If calcium and if sulfate ions both exceed 20 milliequivalents per liter in the saturation extract, the maximum salinity shall be 4.0 dS/m.
 3. Chloride - The maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 150 mg/l (parts per million).
 4. Boron - The maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1 mg/l (parts per million).
 5. Sodium Adsorption Ratio (SAR) - The maximum SAR shall be 3 measured per Method 20b, USDA Handbook Number 60.

6. Aluminum – Available aluminum measured with the Ammonium Bicarbonate/DTPA Extraction shall be less than 5 parts per million.
7. Soil Organic Matter Content - Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter.
8. Calcium Carbonate Content - Free calcium carbonate (limestone) shall not be present.
9. Heavy Metals - The maximum permissible elemental concentration in the soil shall not exceed the following concentrations:

10.

Ammonium Bicarbonate/DTPA Extraction	Parts per million (mg/kilogram) Dry Weight Basis
arsenic	1
cadmium	1
chromium	10
cobalt	2
lead	30
mercury	1
nickel	5
selenium	3
silver	0.5
vanadium	3

- a. If the soil pH is between 6 and 7, the maximum permissible elemental concentration shall be reduced 50%. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be reduced 75%. No more than three metals shall be present at 50% or more of the above values.
- H. Phytotoxic constituent, herbicides, hydrocarbons etc. - Germination and growth of monocots and dicots shall not be restricted more than 10%. Total petroleum hydrocarbons shall not exceed 50 mg/kg dry soil measured per the modified EPA Method No. 8015. Total aromatic volatile organic hydrocarbons (benzene, toluene, xylene and ethylbenzene) shall not exceed 0.5 mg/kg dry soil measured per EPA Methods No. 8020.
- I. Existing Soil to be amended: Inspect existing soil and do all work necessary to bring it to standards specified under "Topsoil" above. Amend as specified herein.
1. The Contractor shall schedule a site visit with the Landscape Architect for the purpose of obtaining a soil analysis. Samples shall be taken from five typical tree/planting locations and delivered by the Contractor to the designated soil testing laboratory. Submit soils analysis and recommendations to the Landscape Architect for acceptance. Soil analysis shall indicate quantities, chemical properties and recommended manufacturer or supplier.
 2. Areas of existing soil to be amended shall be all areas to be planted. Modified amending without tilling is required in slope areas. Turf and grass shall receive full soil preparation.

2.2 ORGANIC AMENDMENTS

- A. Compost Amendment: Acceptable products are finely ground tree and shrub trimmings and vegetable products that have been decomposed and fully composted at least 120 days.
1. Humus material shall have an acid-soluble ash content of no less than 6% and no more than 20%.
 2. The pH of the material shall be between 6 and 7.5.
 3. The salt content shall be less than 10 millimho/cm @ 25° C. on a saturated paste extract.
 - a. Higher amounts of salinity may be present if the soils are to be preleached to reduce the excess or if the plant species will tolerate the salinity. Final determination will be made during soil testing and recommendations.
 4. Boron content of the saturated extract shall be less than 1.0 parts per million.
 - a. Higher amounts of boron may be present if the soils are to be preleached to reduce the excess or if the plant species will tolerate the boron. Final determination will be made during soil testing and recommendations.
 5. Silicon content (acid-insoluble ash) shall be less than 50%.
 6. Calcium carbonate shall not be present if to be applied on alkaline soils.
 7. Types of acceptable products are composts, manures, mushroom composts, straw, alfalfa, peat mosses etc. low in salts, low in heavy metals, free from weed seeds, free of pathogens and other deleterious materials.
 8. Composted wood products are conditionally acceptable [stable humus must be present]. Wood based products are not acceptable which are based on red wood or cedar.
 9. Sludge-based materials are not acceptable if the soil already has a high level (toxic level) of zinc, copper or other heavy metals based on soil analysis.
 10. Carbon:nitrogen ratio is less than 25:1.
 11. The compost shall be aerobic without malodorous presence of decomposition products.
 12. The maximum particle size shall be 0.5 inch, 80% or more shall pass a No. 4 screen for soil amending. The maximum particle size shall be 0.25 inch for hydroseeding.
- B. Maximum total permissible pollutant concentrations in amendment in parts per million on a dry weight basis:

Item	Parts Per Million Maximum		Item	Parts Per Million Maximum
arsenic	20		mercury	10
copper	150		vanadium	500
selenium	50		cobalt	50
cadmium	15		molybdenum	60
lead	200		zinc	300
silver	10		nickel	100
chromium	300			

2.3 IMPORT AMENDMENT AND SOIL FOR PARTICULAR PLANTS:

- A. The following materials are to be used for acid loving plant beds:
 - 1. Azalea Mix as mixed and provided containing composted green waste, sand and soil by Soil Building Systems or approved equivalent. pH to be between 4.5 and 6.5. Provide sample to laboratory for testing and recommendations. Provide additional sample to Landscape Architect.
- B. The following materials are to be used for cactus planting:
 - 1. Very sandy loam with pH of 6.5 to 6.8. Provide sample to laboratory for testing and recommendations. Provide additional sample to Landscape Architect.
- C. The following materials are to be used for on structure lawn planting areas:
 - 1. Very sandy loam with pH of 6.5 to 6.8. Provide sample to laboratory for testing and recommendations. Provide additional sample to Landscape Architect.

2.4 SOIL MIXES:

- A. All soil mixes shall be tested and submitted for review by Landscape Architect, in addition to initial topsoil testing, per Section 32 9113 – Section 1.3.H
- B. All soil mixes shall be tested and submitted for review by Landscape Architect and Structural Engineers the amended soil weight at saturation.
- C. All amended soil depths are as noted herein or per the contract plans.
- D. Planting Mix or Preparation Layer (8" depth) for On-Grade Planting or Pocket Plant Pits: Thoroughly mix the following components into one (1 cy) cubic yard of backfill mix:
 - 1. 70% by volume of on-site topsoil or approved imported topsoil
 - 2. 10% by volume of expanded shale (1/8" to 1/4" diameter)
 - 3. 20% by volume of organic compost
 - 4. 1/3 pound (lb) ammonium sulfate
 - 5. 1/2 pound (lb.) of triple super phosphate
 - 6. 1/2-pound (lb.) potassium sulfate (0-0-50)
 - 7. 2 pounds (lbs.) agricultural gypsum
 - 8. Mycorrhizal Inoculum – (granular at 1 lb. per 1000 sq., ft.)
- E. Planting Mix (full depth) for On-Structure Planting: Thoroughly mix the following components into one (1 cy) cubic yard of backfill mix:
 - 1. 70% by volume of approved topsoil
 - 2. 20% by volume of expanded shale (1/8" to 1/4" diameter)
 - 3. 10% by volume of organic compost
 - 4. 1/3 pound (lb.) ammonium sulfate
 - 5. 1/2 pound (lb.) of triple super phosphate
 - 6. 1/2-pound (lb.) potassium sulfate (0-0-50)

7. 2 pounds (lbs.) agricultural gypsum
 8. Mycorrhizal Inoculum – (granular at 1 lb. per 1000 sq., ft.)
- F. Planting Mix (full depth) for On-Structure Lawn and Turf Areas: Thoroughly mix the following components into one (1 cy) cubic yard of backfill mix:
1. 40% by volume of approved topsoil
 2. 25% by volume of expanded shale (1/8" to 1/4" diameter)
 3. 25% by volume USGA Sand
 4. 10% by volume of organic compost
 5. 1/3 pound (lb.) ammonium sulfate
 6. 1/2 pound (lb.) of triple super phosphate
 7. 1/2-pound (lb.) potassium sulfate (0-0-50)
 8. 1 pounds (lbs.) agricultural gypsum
 9. Mycorrhizal Inoculum – (granular at 1 lb. per 1000 sq., ft.)

2.5 CHEMICAL ADDITIVES:

- A. The following additives may or may not be used depending on the outcome of the soils report.
1. Ground Limestone: Agricultural limestone containing not less than 85% of total carbonates, ground to such fineness that 50% will pass #100 sieve and 90% will pass #20 sieve.
 2. Dolomite Lime: Agricultural grade mineral soil conditioner containing 35% minimum magnesium carbonate and 49% minimum calcium carbonate, 100% passing #65 sieve. "Kaiser Dolomite 65 AG" as manufactured by Kaiser, Inc. Mineral Products Department, or equal.
 3. Gypsum: Agricultural grade product containing 90% minimum calcium sulfate dihydrate.
 4. Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20% to 30% iron and 35% to 40% sulfur.
 5. Sulfate of Potash: Agricultural grade containing 50% to 53% of water-soluble potash.
 6. Single Superphosphate: Commercial product containing 20% to 25% available phosphoric acid.
 7. Ammonium Sulfate: Commercial product containing approximately 21% ammonia measured as nitrogen.
 8. Ammonium Phosphate: Commercial product containing approximately 18% ammonia measured as nitrogen and 48% phosphoric acid.
 9. Ammonium Nitrate: Commercial product containing approximately 17% ammonia measured as nitrogen and 17% nitrate nitrogen.
 10. Calcium Nitrate: Agricultural grade containing 15.5% nitrogen and 21% calcium.
 11. Urea Formaldehyde (Urea-Form): Granular commercial product containing 38% slow release nitrogen with a minimum of 23% WIN (water insoluble nitrogen).
 12. I.B.D.U. (Iso Butyldiene Diurea): Commercial product containing 31% slow release nitrogen.
 13. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96% sulfur.
 14. Iron Sequestrene: Geigy Iron Sequestrene 138 Fe (Iron EDDHA)

15. Gro-Safe: Herbicide absorbent as manufactured by American Norit Company of Jacksonville, FL (800) 641 9245).
16. Mycorrhizal additive/Restorative: JRM Chemical, Cleveland Ohio, 800-962-4010 or Tri-C Natural Solutions, Chino, California 800-927-3311 or approved equal.

2.6 WATER: Clean, fresh and potable, furnished and paid for by Owner.

PART 3 - EXECUTION

3.1 SOIL PREPARATION

A. General:

1. Moisture Content: Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content.

B. Preparation of Existing Soil:

1. Verification of Existing Grades: Verify that grades are within 1 in. plus or minus of the required finished grades. Report all variations to the Landscape Architect.
2. Clearing of Debris: Clear all planting areas of stones 1 in. diameter and larger, weeds, debris and other extraneous materials prior to amending existing soil or spreading imported topsoil.
3. Cultivation: Rip or cultivate all on-grade planting areas to a depth of 12 inches immediately prior to amending existing soil or placing topsoil. Rototill to reduce soil clods to a maximum diameter of one (1") inch in the top six (6") inches. Do not rototill within the existing tree areas.

- C. If rock, road base or similar material is encountered, remove that material is encountered, remove that material to full depth plus two inches and haul and dispose of offsite at the direction and approval of the owner's representative.

3.2 SOIL CONDITIONING

A. Amending of Existing Soil:

- B. Verification: Do not commence amending of existing soil prior to acceptance by Landscape Architect of soil preparation.

3.3 Application Rate: Apply to all planting areas at the following rates per 1,000 square feet:

1. 3 cubic yards organic amendment as specified

2. 5 pounds ammonium sulfate
 3. 6 pounds super phosphate
 4. 8 pounds potassium sulfate (0-0-50)
 5. 35 pounds agricultural gypsum
 6. (Other Chemical additives per soils report, if any)
 7. Areas to receive Hydroseeding: Delete fertilizer and gypsum component; provide incorporated organic amendments as specified.
- B. Incorporation of Amendments: Incorporate homogeneously and thoroughly with top 6 in. of soil layer and bring amended soil to finish grades and elevations shown on Drawings. Do not work soils under muddy conditions.
- C. Surface broadcast amendments at 1/3 the specified rate in the existing tree areas prior to hand soil conditioning or raking, do not otherwise incorporate.

3.4 SOIL PERCOLATION TESTING

- A. Type/Quantity: During operations of Agronomic Soil Fertility Testing and prior to installing Plant Material, Contractor shall perform Soil Percolation Tests, through the direction of the Landscape Architect, in selected representative areas of the Project Site, to verify acceptable natural drainage, soil structure, and soil composition. Contractor shall verify the locations of the Soil Percolation Tests with the Landscape Architect.
- B. Procedure: Each Soil Percolation Test shall be performed as follows:
1. Dig a hole: 2'-0" wide x 2'-0" long x 2'-0" deep.
 2. Fill the hole with water to top and cover with plywood and barricade. Allow hole to drain and fill again to top.
 3. Make twice daily observations, noting the depth of water each day.
 4. Report findings, in writing, to the Landscape Architect. Include the length of time the water takes to drain completely from each hole, date of test, location, and other information, which may be useful in providing further recommendations.
- C. Results: Based on the combined results of the Agronomic Soil Fertility Testing and the Soil Percolation Tests, Contractor may be required to install additional tree drainage sumps or other drainage methods at each planting pit for trees larger than 15-gallon container stock. This does not relieve the Contractor's obligation within the Base Bid to provide the required Tree Root Aeration Units indicated in Section 329400 – Landscape Planting Accessories. Contractor shall include, as a line-item price within the Base Bid, the price per each additional tree drainage sump, should they be required (based on the testing). Should additional tree drainage sumps or other methods be required, compensation shall be awarded to the Contractor at the line-item price (each) as provided by the Contractor.

3.5 SOIL MOISTURE CONTENT

- A. General: Do not work soil when moisture content is so great that excessive compaction occurs, or when it is so dry that dust will form in air, or that clods will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content for tilling and planting. Soil moisture level prior to planting shall be no less than 75% of field capacity. The determination of adequate soil moisture for planting shall be the judgment of the Landscape Architect. Range: Maintain within two-percent (2%) above or below optimum moisture content at times during Work.

3.6 PROTECTION OF SITE

- A. Contractor shall protect existing and new improvements and systems installed prior to planting installation. Maintain protection in place until completion of Work and contracted Landscape Establishment Period.
- B. Protect concrete paving, headers, and drainage from staining due to contact with wet nitrogen stabilized mulch/sawdust, or contact with chelated iron. Correct any stained concrete.

3.7 DRAINAGE OF PLANTING AREAS

- A. Surface Drainage:
 - 1. Discrepancies: Provide proper surface drainage of planted areas. Submit in writing all discrepancies in the Contract Drawings or Specifications, or prior Work done by others, which Contractor feels precludes establishing proper drainage.
 - 2. Correction: Include description of work required for correction or relief of said condition.
- B. Detrimental Drainage, Soils and Obstructions:
 - 1. Notification: Submit in writing all soils or drainage conditions considered detrimental to growth of plant materials. State condition and submit proposal and cost estimate for correcting condition.
 - 2. Correction: Submit for acceptance a written proposal and cost estimate for the correction before proceeding with Work.
 - 3. Obstructions: If rock, underground construction Work, tree roots, or other obstructions are encountered in the performance of Work under this Section, submit cost required to remove the obstructions to a depth of not less than six-inches (6") below the required soil depth.

3.8 CLEAN UP AND PROTECTION

- A. For Work under this Section, keep Work area in a clean, orderly, and safe condition. Contractor shall remove trash caused from his Work on a weekly basis throughout the duration of the Work.

- B. Upon completion of his Work under this Section, the Contractor shall remove rubbish, waste, debris, excess construction materials, and other items resulting from construction operations offsite as described herein this Section, as directed by the Landscape Architect.

END OF SECTION

SECTION 329200 - LAWNS AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Turf Grass and/or Ornamental Groundcover (via sown seed, stolon, plug, hydromulch or sod) planting installation, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Sodded Turf Grasses.
 - 2. Seeded Turf Grasses.
 - 3. Seeded Native and Ornamental Grasses (Machine broadcast).
 - 4. Seeded Native and Ornamental Grasses (Hydroseeded).
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 32 8400 "Planting Irrigation".
 - 3. Section 31 2219 "Landscape and Fine Grading".
 - 4. Section 32 9113 "Soil Preparation".
 - 5. Section 32 9813 "Landscape Establishment Period".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASPA – American Sod Producers Association.
 - 2. AOSA – Association of Official Seed Analysts.
- B. Definitions:
 - 1. Plant Material(s): Refers to living plant species, inclusive of turf grass (via sown seed, stolons, and/or sod), ornamental grasses or groundcovers (via sown seed or sown plugs) for the Project.
 - 2. Planting Area (PA): As denoted on the Contract Drawings, shall refer to areas to be installed with Plant Material(s), or areas where existing vegetation shall be protected.
 - 3. Hydro-Mulching: Refers to the practice of sowing seeds (via hydro-seeding method) or stolons (via hydro-stolonizing method) together within a slurry mixture of water, fertilizer, cellulose (wood) fiber mulch, binder additive / soil and mulch tackifier, and

other additives and materials, which is sprayed uniformly on a prepared soil surface through a pressurized distribution system.

C. Measurements:

1. SQ/FT: Measurement, in square-foot.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Samples and Product Data: Submit samples, certification, and manufacturers' literature for the following items:
 1. Seed Varieties: Guaranteed statement of composition, mixture and percentage of purity and germination of each variety
 2. Sod Information and Certification
 3. Mulch: Manufacturers literature
 4. Soil Stabilizer: Manufacturers literature
 5. Fertilizer: Manufacturers literature
 6. Erosion Control Fabric
- H. Test Data: Submit all laboratory test data for all materials.
 1. Owner's Test: The Owner may choose to test the seed or seed mixes. The Contractor shall be notified.

- I. Submittal Schedule: All products in this section that are required for submittal shall be included in one (1) Division 2 submittal package.
- J. Samples: (Not Required).

1.4 QUALITY ASSURANCE AND CONTROL

- A. Certificates of Inspection: Provide as required by law for transportation of each shipment of seed along with invoice. Submit copies of certificates after acceptance of material. Inspection by Federal or State Governments at place of growth does not preclude rejection at project site.
 - 1. Sod: Shall be subject to inspection and approval by Landscape Architect at the site upon delivery for conformity to specifications. Such approval shall not impair the right of inspection and rejection during progress of the work. Landscape Architect reserves right to refuse inspection at this time if, in his judgment, a sufficient quantity of sod is not available for inspection.
 - 2. Seed: The Landscape Architect shall be furnished a signed copy of statement from vendor, certifying that each container of seed delivered is labeled in accordance with the Federal Seed Act and is at least equal to requirements previously specified. Seed analysis shall be furnished prior to commencement of planting operations. Each lot of seed may be resampled and retested in accordance with latest Rules and Regulations under the Federal Seed Act at the discretion of the Landscape Architect. If these tests reveal the seed to be below the specified pure live seed content, the Contractor shall be required to plant additional seed to compensate for the deficiency at no additional cost to the Owner. The State Seed Laboratory will conduct the seed retests. Allowance will be made for the actual pure live seed content of the specified grasses in determining the actual planting rate.
- B. Inspections:
 - 1. Make written request for inspection after seeding or sodding operations have been completed. Such inspection is for the purpose of commencement of the Landscape Establishment Period.
 - 2. Submit written requests for inspections to the Landscape Architect at least seven (7) days prior to anticipated inspection date.
- C. Applicable Standards: Apply the current or latest editions of the standards for seed as described in the following:
 - 1. Hortus III - 1976 Edition, Bailey Horatorium, Cornell University.
 - 2. Federal Seed Act.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Seed:
 - 1. Delivery: Furnish standard seed in unopened manufacturer's standard containers bearing original certification labels showing quantity, analysis and name of manufacturer.

2. Storage: Store seed with protection from weather or other conditions that would damage or impair the effectiveness of the product.
- B. Mulch: Each package of cellulose fiber shall be marked by the manufacturer to show the air dry weight content.
- C. Sod:
 1. Harvest and Delivery: Harvest from the source and deliver to project site within 24 hours. Deliver only as much sod as can be installed in one day's work.
 2. Review: Sod not transplanted within this time period shall be reviewed prior to installation.
- D. Product Storage:
 1. Protect products from weather or other conditions that would damage or impair the effectiveness of the items.

1.6 PROJECT/SITE CONDITIONS

- A. General Requirements: Installation under this Section shall be performed only during the time of day and during seasons when satisfactory results can be expected, unless authorized by the Landscape Architect.
 1. Seeds: Install immediately after finish grading and irrigation installation are accepted.
 2. Sod: Install immediately after finish grading and irrigation installation are accepted.
 3. Stolons: Install immediately after finish grading and irrigation installation are accepted.
 4. Plugs: Install immediately after finish grading and irrigation installation are accepted.
- B. Climate Restrictions: Do not install Plant Materials under this Section during rainy or inclement weather.
- C. Hydro-mulching Operations:
 1. Irrigated Areas: Commence Work within fourteen (14) calendar days after the completion and acceptance of Soil Preparation (per Section 329113 – Soil Preparation.) in planting areas.
 2. Un-irrigated Areas: Commence work only as soon as the area is ready, Contractor is responsible to provide temporary irrigation, as required, to un-irrigated areas to insure proper germination and growth establishment of the seeded and / or hydro-mulch to meet a minimum of 95% coverage of the hydro-mulched areas to satisfy Final Acceptance requirements.

1.7 SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended

performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.

- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

1.8 ANALYSES OF SAMPLES AND TESTS

- A. Samples: Landscape Architect reserves the right to take and analyze samples of materials for conformity to specifications at any time. Furnish samples upon request.
- B. Rejected Materials: Remove rejected materials immediately from the site at Contractor's expense. Pay cost of testing of materials not meeting specifications.

1.9 ESTABLISHMENT PERIOD AND FINAL ACCEPTANCE: See Section 329813 "Landscape Establishment Period".

1.10 PROTECTION OF ADJACENT AND EXISTING LAWNS TO REMAIN:

- A. Do not store materials or equipment, permit burning, or operate or park equipment on existing lawn areas to remain except as actually required for construction in those areas.
- B. Provide barricades, fences or other barriers as necessary to protect existing lawns to remain from damage during construction.
- C. Notify Landscape Architect in any case where Contractor feels grading or other construction called for by Contract Documents may damage existing lawns to remain.
- D. If existing lawn areas to remain are damaged during construction, Contractor shall replace such lawn areas of the same quality as those damaged at no cost to Owner. Determination of extent of damage and value of damaged lawns shall rest solely with Landscape Architect.

1.11 WARRANTY PERIOD

- A. Time Period: Warrant that all lawns, sodded areas, hydromulch meadow and grass areas will be in a healthy and flourishing condition of active growth twelve (12) months from date of Substantial Completion (site related if multiple).
- B. Appearance During Warranty: All grassed areas shall be free of dead or dying patches, and all areas shall show foliage of a normal density, size and color for the season during which it is reviewed

- C. Delays: All delays in completion of planting operations which extend the planting into more than one planting season shall extend the Warranty Period correspondingly.
- D. Coverage: Warrant growth and coverage of lawn and meadow planting to the effect that:
 - 1. For meadows: a minimum of 95% of the area planted shall be covered with specified planting after one growing season with no bare spots.
 - 2. For Sod: Complete lush cover with no brown sections, edges, seams or cracks showing. Sod shall have established to the extent that satisfactory capillary action between the sod and soil has been established. 100 per cent coverage.
 - 3. For Seed: Ninety-eight (98%) percent uniform coverage of grass in excess of one (1") inch height. No bare spots of greater than one half (1/2) square foot and no aggregate bare areas in any 100 square feet greater than 2 square feet.
- E. Exceptions: Contractor shall not be held responsible for failures due to neglect by Owner, vandalism, etc., during Warranty Period. Report such conditions in writing.

1.12 FINAL ACCEPTANCE:

- A. Work under this Section will be accepted by Landscape Architect upon satisfactory completion of all work, but exclusive of re-application under the Guarantee Period. Final Acceptance of lawn establishment shall be as follows:
 - 1. For Sod: Complete lush cover with no bare or brown sections and no seams or cracks are showing. Sod shall have established to the extent that satisfactory capillary action between the sod and soil has been established and there are no bare areas.
 - 2. For Seed: Complete coverage with no more than 30% soil visibility levels. Coverage must be equal and well distributed over entire area.
 - 3. The Landscape Architect and/or Owner shall interpret the above. Upon Final Acceptance, the Owner will assume the responsibility for maintenance of the work.

1.13 REPLACEMENTS

- A. Unacceptable Workmanship: Hydroseed areas exhibiting conditions that are determined as unacceptable workmanship shall be repaired and/or replaced at no additional cost to the Owner.
- B. Replacements: Replace, without cost to Owner, and as soon as weather conditions permit, all hydroseed not in a vigorous, thriving condition, as determined by Landscape Architect during and at the end of Warranty Period.
- C. Matching: Closely match all replacement seed with adjacent areas of lawn or grass. Apply all requirements of this Specification to all replacements.

PART 2 - PRODUCTS

2.1 SOD

- A. One-year old sod, variety as shown on the drawings.

1. Sod shall be dense with the grass having been mowed at one (1") inch height before lifting from field. All grown on fumigated soil.
2. Sod shall be in vigorous condition, dark green in color, free of disease and harmful insects.
3. Do not stack for more than twenty-four (24) hours between time of cutting and time of delivery.
4. Landscape Architect reserves the right to reject any sod deemed unacceptable for installation.

2.2 LAWN SEED

- A. Composition: Fresh, clean, certified, Class 'A', new crop seed.
- B. Weed Seed: Do not exceed 0.25%.

2.3 GRASS AND LAWN

- A. Refer to the various seed types on the drawings.

2.4 FERTILIZER FOR TANK MIX

- A. Shall be as established through soil testing, pelleted, uniform in composition, free-flowing, and suitable for application with approved equipment. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable State fertilizer laws, and bearing the name or trademark and warranty of the producer.

2.5 MULCH

- A. General:
 1. Composition: Green-colored, fibrous, virgin wood cellulose mulch containing no growth or germination-inhibiting factors.
 2. Dispersion in Slurry: Mulch shall be manufactured in such manner that after addition to and agitation in slurry tanks with fertilizer, seed, water and other approved additives, fibers in the material will become uniformly suspended to form a homogeneous slurry.
 3. Absorption Capacity: When hydraulically sprayed on the ground, the material will form a blotter-like groundcover impregnated uniformly with seed which will allow the absorption of moisture and allow rainfall to percolate to the underlying soil.
- B. Specifications:
 1. Weight: Weight specifications of this material from suppliers, and for all applications, shall refer only to air dry weight of the fiber material. Absolute air dry weight is based on the normal standards of the Technical Association of the Pulp and Paper Industry for wood cellulose and is considered equivalent to 10% moisture.
 2. Labeling: Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content.

2.6 HYDRAULIC EQUIPMENT FOR HYDROMULCH SEEDING

- A. Mixer: Use a commercial type hydro-seeder for the application of slurry. Equipment shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend and homogenously mix slurry.
 - B. Distribution Lines: Large enough to prevent stoppage and to provide even distribution of the slurry over the ground.
 - C. Pump Capacity: 150 psi at the nozzle.
 - D. Slurry Tank: Minimum capacity of 1000 gallons and shall be mounted on a traveling unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution without waste.
- 2.7 WATER: Potable water as furnished by Owner. Transport as required.
- 2.8 HYDROMULCH SEEDING MIX PER ACRE (If applicable)
- A. Lawn – Refer to Contract Drawings for seeding species:
 - 1. Mulch - 1,200 to 1,500 lbs. per acre
 - 2. Fertilizer - 500 lbs.
 - B. Other species material is to be applied per applications rates provided as recommended by supplier if varies from above.
- 2.9 FIBER MULCH
- A. Mulch Components:
 - 1. For use with the hydraulic application of grass seed and fertilizer, shall consist of specially prepared mulch.
 - 2. It shall be processed in such a manner that it will not contain germination or growth inhibiting factors.
 - 3. It shall be dyed an appropriate color to allow visual metering of its application.
 - 4. The mulch shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like groundcover which readily absorbs water and allows infiltration to the underlying soil.
 - 5. Weight specifications from suppliers for all applications shall refer only to air dry weight of the fiber, a standard equivalent to eighteen (18%) percent moisture. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and be marked by the manufacturer to show the dry weight content.
 - 6. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that it meets all of the foregoing requirements.
 - B. Soil Stabilizer:
 - 1. Composition: Totally organic substance, supplied in powder form and at least 90% of which is 92% pure muciloid derived from ground *Plantago ovata-insularis* husks. Stabilizer shall be water-soluble, non-toxic hydrophilic and shall not inhibit germination.

2. Product: "Ecology Controls M-binder" by Ecology Controls, (213) 877-8600, or "R-Binder" by Clyde Robin Seed Co., (415) 785-0425.

C. Mulch and Soil Stabilizer:

1. Composition: Pre-mixed, organic-based combination of virgin-wool fiber and stabilizing agent with no growth or germination-inhibiting elements.
2. Product: "Hydro Mulch 2000 Fiber" by Conwed Corporation., (612) 221-1190.
- 3.
- 4.

2.10 TOPSOIL AND SAND

- A. Shall be as specified in Section 32 9113 "Soil Preparation".

2.11 TOP-DRESS SOIL MIX

A. Blend

1. 1/4 Cubic Yard Topsoil (25%)
2. 3/4 Cubic Yard Sand (75%)
- 3.

- 2.12 WATER: Shall be free from oil, acid, alkali, salt, and other substances harmful to growth of grass. The water source shall be subject to approval prior to use.

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

3.2 EXAMINATION

A. Verification of Conditions:

1. Grades: Verify that grades are within 1 in. plus or minus of the required finished grades. Verify that erosion control materials have been installed in other sections. Report all variations in writing.
2. Stones, Weeds, Debris: Verify that all areas to receive lawns and grasses are clear of stones larger than 3/4 inch in diameter, weeds, debris and other extraneous materials.

3.3 GENERAL

- A. Areas to Receive Hydroseeding: All designated areas as delineated on the Drawings.

- B. Perform seeding on a section-by-section basis and after approval of Landscape Architect of graded condition. Complete areas in a continuous manner.
- C. Scheduling:
 - 1. Irrigated Areas: Within fourteen (14) calendar days after the completion of finish grading in any area. In the event of anticipated bad weather conditions, apply immediately.
 - 2. Un-irrigated Areas: 2 days prior to installation of temporary irrigation installation.
- D. Exiting lawn interface:
 - 1. Work new and existing lawn or meadow areas edges together such that after new material has established the appearance will be a generally seamless in appearance.

3.4 SPECIAL MULCHING EQUIPMENT

- A. Hydraulic equipment used for the application of fertilizer, seed, and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing up to forty (40) pounds of fiber plus a combined total of seventy (70) pounds of fertilizer solids for each one hundred (100) gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which provide even distribution of the slurry on the slopes to be seeded. The slurry tank shall have a minimum capacity of eight hundred (800) gallons and shall be mounted on a traveling unit which may be either self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution without waste. The Landscape Architect may authorize equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.
- B. Mixing: Care shall be taken that the slurry preparation takes place on the site of the work. The slurry preparation should begin by adding water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, good recirculation shall be established and seed shall be added. Fertilizer shall then be added, followed by wood pulp mulch. The wood pulp mulch shall only be added to the mixture after the seed and when the tank is at least one-third filled with water. The engine throttle shall be opened to full speed when the tank is half filled with water. All the wood pulp mulch shall be added by the time the tank is two-thirds to three-fourths full. Spraying shall commence immediately when the tank is full. The operator shall spray the area with a uniform, visible coat by using the green color of the wood pulp as a guide.
- C. Application:
 - 1. Contractor shall obtain approval of hydromulch area preparation from the Landscape Architect prior to application.
 - 2. Operators of hydromulching equipment shall be thoroughly experienced in this type of application. Apply specified slurry mix in a motion to form a uniform mat at specified rate.

3. Keep hydromulch within areas designated and keep from contact with other plant material.
 4. Slurry mixture which has not been applied within four (4) hours of mixing shall not be used and shall be removed from the site.
 5. After application, the Contractor shall not operate any equipment over the covered area.
 6. Immediately after application, thoroughly wash off any plant material, planting areas, or paved areas not intended to receive slurry mix. Keep all paved and planting areas clean during maintenance operations.
 7. Refer also to the maintenance portion of this Section.
- D. Unseeded Areas: If, in the opinion of the Landscape Architect, unplanted skips and areas are noted after hydromulching, the Contractor shall be required to seed the unplanted areas with the grasses that were to have been planted at no additional cost to the Owner.

3.5 SOIL PREPARATION AND CONDITIONING

- A. Verification:
1. Stones, Weeds, Debris: Verify that all areas to receive lawns are clear of stones larger than 1-1/2 in. diameter, weeds, debris and other extraneous materials.
 2. Grades: Verify that grades are within 1 in. plus or minus of the required finished grades. Report all variations in writing.
- B. Soil Moisture:
1. Excessive Moisture: Do not commence work of this section when soil moisture content is so great that excessive compaction will not occur, nor when it is so dry that dust will form in air or that clod will not break readily.
 2. Inadequate Moisture: Apply water, as necessary, to bring soil to optimum moisture content for planting.
- C. Existing trees: Insure soil preparation within the drip lines of existing trees is by hand and in compliance with Section 329113 "Soil Preparation".
- D. Soil Conditioning for all meadow grass areas:
1. Rip soil to a depth of 6 inches minimum on 12-inch centers
 2. Relieve compaction construction traffic and compacted areas by ripping soil to a depth of 12 inches and 12-inch centers.
 - a. In any existing tree areas, reduce tilling to a maximum of 2-inch depth.
 3. Apply compost prior to final tilling at 2 yards per 1,000 sq. ft.
 4. Rototill ripped soil with compost surfacing to a depth of 6 inches to reduce clods and soil to less than 1-inch diameter.
 5. Fine grade
 6. Apply Hydro-mulch seeding as specified.
- E. Soil Conditioning for Sod and Turf Seed Areas:

1. Comply with requirement above. Apply fertilizer during hydro mulch process.

3.6 HYDROSEED

A. Preparation: Do all slurry preparation at the job site.

1. Water: Add water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, establish good re-circulation and add seed.
2. Seed: Do not allow seed to remain more than 30 min. in slurry.
3. Fertilizer: Add fertilizer, followed by the mulch. The mulch shall only be added to the mixture after the seed, and when the tank is at least 1/3 filled with water.
4. Mixing: Open the engine throttle to full speed when the tank is half-filled with water. Add all the mulch by the time the tank is 2/3 to 3/4 full. Commence spraying immediately when the tank is full.

B. Application:

1. General: Apply specified slurry mix in a sweeping motion to form a uniform mat at the specified rate. Keep hydroseeding within designated areas and keep from contact with other plant materials.
2. Unused Mix: Do not use slurry mixture that has not been applied within 4 hours of mixing. Promptly remove from the site.
3. Protection: After application, do not operate any equipment over the hydroseeded areas.
4. Reseeding: Reseed all areas and parts of areas that fail to show a uniform stand until all areas are satisfactorily covered.

3.7 SODDING ON PREPARED FINISHED GRADE

- #### A. Bed Preparation: Immediately after the soil preparation is completed and finished grade has been approved, begin sodding operations. If sod bed is dry immediately prior to sod installation, dampen surface with a fine mist of water.

3.8 DRILLED SEEDING ON PREPARED FINISHED GRADE

- #### A. Immediately after finished grade has been approved, begin seeding operations. Lightly disc seed bed surface to a depth of on-quarter (1/4") inch immediately before seeding operations.
- #### B. Apply seed by mechanical "culti-packer" type or approved similar equipment. Cover the seed and form the seed bed in one operation. In areas inaccessible to culti-packer, seed by hand.
- #### C. Take extreme care during seeding and raking to ensure that no change occurs in finish grades and that seed is evenly distributed over entire seed bed.
- #### D. Roll seeded bed with 200-pound ballast roller.
- #### E. Water with fine spray.

3.9 CLEAN-UP

- A. General: Keep all areas of work clean, neat and orderly at all times. Keep all paved areas clean during planting operations.
- B. Overspray: Immediately after application, thoroughly wash off any plant materials, planting areas, or paved areas not intended to receive slurry mix.
- C. Debris: Clean up and remove all deleterious materials and debris from the entire work area prior to Final Acceptance.

END OF SECTION

SECTION 329300 - TREES, SHRUBS, VINES AND GROUNDCOVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Exterior Landscape Planting installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Excavation of plant pits and beds
 - 2. Provide related planting items
 - 3. Provide plant materials and related items
 - 4. Finish grading of planted areas
 - 5. Warranty and replacements
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section
 - 2. Section 31 2219 "Landscape and Fine Grading".
 - 3. Section 32 8400 "Planting Irrigation".
 - 4. Section 32 9113 "Soil Preparation".
 - 5. Section 32 9813 "Landscape Establishment Period".
 - 6. Section 33 4300 "Landscape Drainage".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing Materials.
 - 2. USDA – United States Department of Agriculture.
 - 3. ANSI – American National Standards Institute.
- B. Reference Standards:
 - 1. American National Standard for Nursery Stock (ANSI Z60.1). American National Standards Institute, and American Association of Nurserymen, Latest edition,
 - 2. American Joint Committee on Horticultural Nomenclature, 1942 Edition of Standardized Plant Names.
 - 3. Hortus III, 1976 Edition, Liberty Hyde Bailey Hortorium, Cornell University.
 - 4. Manual of Cultivated Conifers, Den Ouden & Boon, 1978.
 - 5. American National Standard for Tree Care Operation, Tree, Shrub, and Other Woody Plant Maintenance (ANSI A300), American National Standards Institute, Latest Edition.

C. Definitions:

1. Plant Material(s) – Refers to living plant species, inclusive of trees, shrubs, groundcovers, vines, ornamental grasses, cacti/succulents, espaliers, annuals, perennials, etc., as indicated in the Contract Drawings.
2. Planting Area (PA) – As denoted on the Contract Drawings, shall refer to areas to be installed with Plant Material(s), or areas where existing vegetation shall be protected.
3. Plant Height – Measurement of main body height, not measurement to branch tip.
4. Plant Spread – Measurement of main body diameter, not measurement from branch tip to branch tip.
5. Amended Planting Backfill Mixture – Refer to Section 329113 – Soil Preparation.
6. Balled and Burlapped Stock – Healthy, vigorous exterior plants with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
7. Balled and Potted Stock – Healthy, vigorous exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
8. Bare-Root Stock – Healthy, vigorous exterior plants grown with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.
9. Clump – Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.
10. Container-Grown Stock – Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.
11. Fabric Bag-Grown Stock – Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.
12. Finish Grade – Elevation of finished surface of planting soil.
13. Manufactured Topsoil – Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
14. Multi-Stem – Where three (3) or more main stems arise from the ground from a single root crown or at a point right above the root crown.
15. Sub-grade – Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
16. Subsoil – All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

D. Measurements:

1. sq/ft: Measurement, in square-foot.
2. o.c.: Measurement used for On-Center spacing.
3. e.w.: Direction of Measurements - Each Way

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
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- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Material Samples and Literature: Submit requested items at least sixty (60) days prior to delivery to site. Attach product name, address of manufacturer and/or supplier and appropriate literature to each sample. Literature or Product Data shall consist of manufacturer's current specifications, with catalog cuts, data sheets and installation instructions.
 - 1. Tree and Shrub Planting Fertilizer: Literature.
 - 2. Wood Chip Mulch: One (1) quart sample and analysis.
 - 3. Vine Ties: Literature and shop drawing of installation details, anchor layout and procedures.
- H. Plant Material Samples: Submit documentation within thirty (30) days after award of Contract that all plant materials have been located and are ready to be secured. Arrange specific review procedure of plant materials at time of submission. Submittals and review shall be organized as follows:
 - 1. Preliminary Review: Submit representative photographs for review of all plant materials in the required sizes and in available quantity at least sixty (60) working days prior to shipment to the site.
 - a. Submittal shall include two (2) items per plant:
 - 1) A minimum of two-color photograph from opposite sides of each tree species
 - 2)

- 3) One color photocopy of the mounted sheet. Include one (1) set for each plant type and size required for the project. The 8 1/2" x 11" sheet is to include the name and address of the supplier, size of the plant in the picture and Botanical and Common name of the plant.
- b. Tree and photographs shall include a person or device to determine scale.
2. Tagging: The Landscape Architect may elect to review any of the material at the place of growth. Upon review and acceptance of plant material photograph, specific items will be selected for field review by the Landscape Architect. The Landscape Contractor shall arrange the review and he shall accompany the Landscape Architect for all reviews and tagging plants at place of growth and upon delivery for conformity to specifications.
3. Photograph Acceptance and Nursery Review: Acceptance of material through photographs does not preclude rejection of unsatisfactory material upon delivery. The Landscape Architect reserves the right to refuse review from photographs or at the grower if, in his judgment suitable material or sufficient quantities are not available. Contractor shall insure a sufficient quantity of plants will be available whenever trips are arranged to a nursery for the purposes of tagging material for the project.
4. Unavailable Material: If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract price. Substantiate such proof in writing no later than fifteen (15) days after award of contract.
5. Distant Material: Submit photographs with a person adjacent to plants for preliminary review. Such review shall not impair the right of review and rejection during progress of the work.
6. Special Conditions: The above provisions shall not relieve Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.
7. Plant material submittals are to begin within two to three weeks after the contractor has been selected and given an official contract. All plant material is to be located, approved, and secured 30 days prior to installation.
- I. Test Reports: One (1) copy to be sent by testing laboratory directly to Landscape Architect.
- J. Submittal Schedule: All products in this section which is required for submittal shall be included in one (1) Division 2 submittal package.

1.4 QUALITY ASSURANCE AND CONTROL

- A. Certificates:
 1. Submit certificates of inspection required by law for transportation of each shipment of plants along with invoice.
 2. File copies of certificates after acceptance of material. Inspection by Federal or State Governments at place of growth does not preclude rejection of plants at project site.
- B. Applicable Standards: Apply standards for plant materials as described in the following:
 1. "Grades and Standards", latest edition, Texas Association of Nurserymen Specifications, Austin, Texas 78704.
 2. "American Standard for Nursery Stock", 1980 Edition, American National Standards Institute, Incorporated, (A.N.S.I. Z60-1-1980).

3. "Standardized Plant Names", 1942 Edition, American Joint Committee on Horticultural Nomenclature.
 4. American Standard for Nursery Stock, 1980 Edition, American Association of Nurserymen, Inc.
 5. Hortus III - 1976 Edition, Bailey Hortorium, Cornell University.
- C. Soil Testing Agency: Wallace Laboratories, 365 Coral Circle, El Segundo, CA 90245. Tel (310)-615-0116, Attn: Mr. Garn Wallace, Ph.D. or approved equal.

1.5 PROJECT/SITE CONDITIONS

A. Protection of Existing Plants to Remain:

1. Operations: Do not store materials or equipment, permit burning, or operate or park equipment under the branches of all existing plants to remain except as actually required for construction and pocket planting in those areas.
2. Barriers: Protect existing barricades, fences or other barriers as necessary at the drip line to protect existing plants to remain from damage during construction.
3. Equipment: Minimal equipment is to be used in the natural areas. Use only light weight rubber tired machines (Bob-Cat or similar) and wheel barrows or plant carts to transport material. Drive machines out of natural areas except as absolutely necessary. Hold a review of proposed paths prior to work.
4. Notification: Notify Landscape Architect when Contractor feels other construction activities may damage existing plants to remain.

B. Replacement of Damaged Plants:

1. Replacement: Replace existing plants to remain which are damaged during construction with accepted plants of the same species and size as those damaged at no cost to Owner.
2. Landscape Architect Role: Determine extent of damage and value of damaged plants.

1.6 WORK SCHEDULE: Proceed with the work as rapidly as the site becomes available, consistent with normal seasonal limitations for planting work.

1.7 SELECTION, ORDERING AND PURCHASE OF CONTRACT GROWN TREE MATERIAL

- A. Tagging: Upon review and acceptance of plant material photographs, specific items will be selected for field review by the Landscape Architect. The Landscape Contractor shall arrange the review and he shall accompany the Landscape Architect for all reviews and tagging plants at place of growth and upon delivery for conformity to specifications.
- B. Unavailable Material: If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract price. Substantiate such proof in writing no later than fifteen (15) days after award of contract.

- C. Special Conditions: The above provisions shall not relieve Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

D.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Labeling: Furnish standard products in manufacturer's standard containers bearing original labels legibly showing quantity, analysis, genus/species and name of manufacturer/grower.
- B. Storage: Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product. Protect metal containers from sun during summer months with temperatures above 80 degrees F.
- C. Handling: Do not lift or handle container plants by tops, stems or trunks at any time. Do not bind or handle plants with wire or rope at any time.
- D. Anti-Desiccant: At Contractor's option, spray all evergreen or deciduous plant material in full leaf immediately before transporting with anti-desiccant. Apply an adequate film over trunks, branches, twigs and foliage.

1.9 ANALYSES OF SAMPLES AND TESTS

- A. Sampling: Right is reserved to take and analyze samples of materials for conformity to specifications at any time. Furnish samples upon request.
- B. Rejected Materials: Remove rejected materials immediately from the site at Contractor's expense. Pay cost of testing of materials not meeting specifications.

1.10 ESTABLISHMENT PERIOD AND FINAL ACCEPTANCE: See Section 32 9813 "Landscape Establishment Period" for requirements under this section.

1.11 WARRANTY PERIOD

- A. Warranty:
 - 1. Warrant that all trees less than 4 1/2" caliper and smaller, shrubs, groundcover, and vines planted under this Contract will be healthy and in flourishing condition of active growth one (1) year from date of Substantial Completion.
 - 2. Warrant that all trees 5" caliper and larger planted under this Contract will be healthy and in flourishing condition of active growth two (2) years from date of Substantial Completion.
- B. Delays: All delays in completion of planting operations which extend the planting into more than one planting season shall extend the Warranty Period correspondingly.

- C. Condition of Plants: Plants shall be free of dead or dying branches and branch tips, with all foliage of a normal density, size and color.
- D. Replacements: As soon as weather conditions permit, replace, without cost to Owner all dead plants and all plants not in a vigorous, thriving condition, as determined by Landscape Architect during and at the end of Warranty Period.
- E. Exclusions: Contractor shall not be held responsible for failures due to neglect by Owner, vandalism, etc., during the Warranty Period. Report such conditions.
- F.

1.12 REPLACEMENTS

- A. General:
 - 1. Plant materials exhibiting conditions which are determined as being unacceptable due to workmanship by the Contractor shall be repaired and/or replaced at no additional cost to the Owner.
 - 2. Closely match replacements to adjacent specimens of the same species. Apply all requirements of this Specification to all replacements.
- B. Replacement Quantities: Contractor shall be held responsible for a maximum of two (2) replacements for each failed tree, shrub and vine, and same area of groundcover planting after final acceptance during the Warranty Period.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

- A. General:
 - 1. Growing Conditions: Plants shall be nursery-grown in accordance with good horticultural practices under climatic conditions similar to those of project for at least two years unless otherwise specifically authorized.
 - 2. Appearance: All plants shall be exceptionally heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be superior in form, number of branches, compactness and symmetry.
 - 3. Vigor: Plants shall be sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall be free of disease, insect pests, eggs, or larvae. They shall have healthy, well-developed root systems. Plants shall be free from physical damage or adverse conditions that would prevent thriving growth.
 - 4. Container Stock: Verify that all container stock has been grown in the containers in which delivered for at least six (6) months, but not over two (2) years. Samples must prove to be free of kinked, circling or girdling roots and with no evidence of a pot-bound condition. Do not install container plants that have cracked or broken balls of earth when taken from container.
- B. Measurements:

1. General: Measure plants when branches are in their normal upright position. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Take caliper measurement at a point on the trunk six (6") inches above natural ground line for trees up to four (4") inches in caliper and at a point twelve (12") inches above the natural ground line for trees over four (4") inches in caliper.
 2. Size Range: If a range of size is given, do not use plant materials less than the minimum size. Not less than sixty (60%) percent of the plants shall be as large as the maximum size specified. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required. Plants that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected.
 - 3.
 - 4.
 5. Substitutions: Substituted plants shall be true to species and variety and shall conform to measurements specified except that plants larger than specified may be used if accepted. Use of such plants shall not increase Contract price. If larger plants are accepted, increase the ball of earth in proportion to the size of the plant.
- C. Pruning: Do not prune plants before delivery. Prune upon acceptance only under review and direction of Landscape Architect.
1. For pruning after installation, refer to Section 329813 "Landscape Establishment Period".
- D. Condition: Trees that have multiple leaders, unless specified, or damaged or crooked leaders, will be rejected. Trees having a main leader shall not have been headed back. Trees with abrasions of the bark, sunscalds, disfiguring knots, or fresh cuts of limbs over three-quarter (3/4") inch that have not completely callused will be rejected.
- 2.2 BACKFILL MIX FOR ON-GRADE PLANT PITS: See Section 329113 "Soil Preparation" for requirements under this section.
- 2.3 COMMERCIAL FERTILIZERS
- A. Tree, Shrub and Vine Planting Fertilizer: "Agriform" 21-gram tablets with 20-10-5 (N-P-K) formula as manufactured by Sierra Chemical Company, Milpitas, California, Telephone (408) 263-8080, or accepted equal.
- 2.4 STAKING/GUYING MATERIALS: Refer to Section 329400 "Landscape Planting Accessories" for requirements under this section.
- 2.5 VINE SUPPORTS: Refer to Section 329400 "Landscape Planting Accessories" for requirements under this section.
- 2.6 WATER

- A. Clean, fresh and potable, furnished and paid for by Owner.
 - B. Transport as required.
- 2.7 WOOD CHIP MULCH: Refer to Section 329400 "Landscape Planting Accessories" for requirements under this section.
- 2.8 ANTI-DESICCANT
- A. At Contractors option, apply anti-desiccants for retarding excessive loss of plant moisture and inhibiting wilt. Material shall be sprayable, water insoluble vinyl-vinyl dine complex that will produce a moisture retarding barrier not removable by rain.
 - 1. Wilt-pruf Formula NCF as manufactured by Nursery Specialty Products, Greenwich, Connecticut, or accepted equal.
- 2.9 DRAINAGE AND SUBDRAINAGE MATERIAL: Refer to Section 334300 "Landscape Drainage" for requirements under this section.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.
 - B. Prior to commencing Work under this Section, Contractor shall examine previously installed Work from other trades and verify that such Work is complete and to the point where Work herein may commence properly. Do not proceed with Work until unsatisfactory conditions have been corrected.
 - C. Installation practices of the Plant Materials shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted horticultural practices, as judged by the Landscape Architect.
 - 1. Soil moisture levels prior to planting shall be no less than seventy-five-percent (75%) of field capacity. The determination of adequate soil moisture for planting shall be in the sole judgment of the Landscape Architect, and their decision shall be final.
 - a. If the soil moisture level is found to be insufficient for planting installation, planting pits shall be filled with water and allowed to drain before commencing planting operations.
 - b. Any planting area that may become compacted in excess of eighty-five-percent (85%) relative compaction (due to construction operations or other activities during the Contract) shall be tilled and thoroughly cross-ripped to a minimum depth of nine-inches (9") to alleviate the condition, taking care to avoid all existing subsurface utilities, drainage, etc.

- c. Do not commence planting installation prior to acceptance of Section 329113 "Soil Preparation".
 - D. Preparation of Planting Installation: Lay out individual Plant Material locations and areas for multiple plantings. Stake locations, outline areas, and gain the Landscape Architect's acceptance prior to commencing physical planting installation. Contractor shall make minor adjustments to the planting layout as required, per the direction of the Landscape Architect.
 - E. No more Plant Materials shall be distributed in the planting area on any day than can be installed and watered on that day. Plant Materials shall be planted and watered immediately after the removal of their containers, as applicable.
 - F. Contractor shall protect existing and new improvements and systems installed prior to planting installation. Maintain protection in place until completion of Work and Landscape Establishment Period.
 - G. Finish Grades for planting areas shall have been established (per Section 312219 – Landscape Grading) prior to Work under this Section. Verify that grades are within one-inch plus or minus (1"+/-) of the required finish grade, and that all proper soil amendments and fertilizers have been furnished and installed accordingly as specified (per Section 329113 – Soil Preparation).
 - 1. Maintain positive surface drainage of all planted areas throughout the duration of the Contract.
 - H. Pre-Planting: Where Plant Materials are to be pre-planted to permit site improvements to be installed around them, Contractor shall be responsible for the accurate layout and placement of those Plant Materials, as measured to their centerlines. Confirm designated pre-planting operations with Landscape Architect prior to commencing Work. Contractor shall also be responsible for the protection of pre-planted Plant Materials while other Work is taking place around them. Provide regular irrigation, as necessary, prior to installation and functioning of irrigation systems (per Section 328400 – Sprinkler Irrigation).
- 3.2 DRAINAGE OF PLANTING AREAS
- A. Surface Drainage: Maintain positive surface drainage of planted areas as established under Section 31 2219 "Landscape and Fine Grading".
 - B. Discrepancies: Submit in writing, all discrepancies in the Drawings or Specifications, obstructions on the site, or prior work done by others, which Contractor feels precludes maintaining proper drainage; include description of all work required for correction or relief of said discrepancies.
 - C. Detrimental Drainage, Soils and Obstructions:
 - 1. Notification: Supply written notification of all conditions detrimental to growth of plant material. State condition and submit proposal and cost estimate for correcting condition.
 - 2. Testing: Test drainage of plant beds and pits by filling with water twice in succession. Give written notification of conditions permitting the retention of water in planting beds for more than twenty-four (24) hours.

3. Correction: Submit for acceptance a written proposal and cost estimate for the correction before proceeding with work.
4. Obstructions: If rock, underground construction work, tree roots or other obstructions are encountered in the excavation of plant pits, alternate locations may be used as directed. Where locations cannot be changed, submit cost required to remove the obstructions to a depth of not less than six (6") inches below the required pit depth. Proceed with work after acceptance.

3.3 LAYOUT PLANTING AREAS

- A. Layout and Staking: Lay out plants at locations shown on Drawings. Use color-coded wire flags for each species of plant material. Stake each tree, vine and major shrub. Outline shrub and groundcover beds with paint. Locations of plants will be checked in the field and will be adjusted to exact position before planting begins. Right is reserved to refuse review at any time if, in the landscape architect's opinion, a sufficient quantity of plants are not available.

3.4 PLANT PIT EXCAVATION

- A. Plant Pits outside natural areas:
 1. Excavate the planting pits for trees and shrubs which shall be three times the diameter and equal to the depth of the root ball. Where adjacent to hardscape, width in the direction of hardscape shall be to hardscape edge unless indicated otherwise in the drawings.
- B. Plant Pits inside natural areas:
 1. Excavate the planting pits for trees shall be 12 inches larger and for groundcover and shrubs which shall be 3 inches larger and equal to the depth of the plant material. Avoid root system and adjust location as needed.

3.5 PLANTING OPERATIONS

- A. General:
 1. Protect plants at all times from sun or drying winds.
 2. Keep plants that cannot be planted immediately upon delivery in the shade, well-protected and well-watered.
- B. Handling of Plant Materials:
 1. Remove canned stock carefully after cans have been cut on two sides with accepted cutter. Do not use spade to cut cans.
 2. Lift and handle plants only from the bottom of the ball. If rootball is cracked or broken during handling, plant shall be rejected.
- C. Installation:
 1. Pit Preparation: Add the appropriate amount of backfill mix to the bottom of the plant pit and blend into the existing soil. Tamp and compact mix.

2. Positioning: After removing plant from container, scarify side of rootball to prevent root-bound condition and position plant in planting pit.
 3. Backfilling: Use site stockpiled soil to backfill on-grade plant pits. Set each plant plumb and brace rigidly in position until planting soil has been tamped solidly around the ball and roots. When plant pits have been backfilled approximately 2/3 full, water thoroughly and saturate rootball, before installing remainder of the backfill mix to top of pit, eliminating air pockets.
 4. Remove top 1/3 minimum of all wiring, rope and burlap as a part of planting operation.
 5. Continue backfill and create maximum 3-inch-high temporary water basin.
 6. Staking and/or Guying: Stake or guy as outlined below.
- D. Adjustment: Adjust plants so that after full settlement has occurred, the natural grade at the base of the plants is flush to a maximum of one (1") inches above the adjacent planting finish grade after natural settlement.
- E. Temporary Watering Basin: Form saucer with three (3") inch high berm centered around the tree and 2" higher around shrub pits. Locate basins at twelve (12") inches wider than ball diameter. Basins will not be permanent.
- F. Watering: Water all plants immediately after planting.
- G. Labels: Remove all nursery-type plant labels from plants.
- H. Temporary Watering Basin: Remove watering basins prior to finish grading and after irrigation is in operation within shrub, groundcover and lawn areas.

3.6 GROUNDCOVER PLANTING

- A. Tilling: Surface soil in areas to be planted with groundcover shall be tilled to a depth of six (6") inches. Planting soil amendments should be uniformly broadcast and thoroughly incorporated to a depth of six (6") inches by means of rototiller or equal. Do not till in existing tree areas.
- B. Planting: Plant groundcover plants at optimum depth for proper growth. Avoid air pockets. Equally space triangularly, at distances called for in the Drawings.

- 3.7 Watering: Water bed thoroughly after fertilizer application. Wash all fertilizer from leaves of plant materials

3.8 STAKING AND GUYING

- A. General:
1. Trees shall be able to stand upright without support, and shall return to the vertical after their tops have been deflected horizontally and released. Stake or guy trees which do not meet this qualification. All plant materials shall remain plumb and straight for all given conditions from installation through the guarantee period.
 2. Use either staking or guying method at Contractor's own option, subject to acceptance.

3. Trees supplied with well-tapered, strong trunks that will stand alone may be staked with two (2) stakes and tied per this section.
4. Tree support, if required, shall be done as outlined in Section 32 9400 "Landscape Planting Accessories".

3.9 TRAINING OF VINES AND ESPALIERS

- A. Anchors: Place as many anchors as required to securely support the plant and its branching structure as directed.
- B. Small Vines: Secure to wall or fence with polyethylene tape at ten (10") inch intervals.

3.10 MULCHING

- A. Install a two (2") inch deep layer of mulch over all shrub areas including tree and shrub watering basins.
- B. Install gravel or aggregate mulch where shown.

3.11 CLEAN-UP

- A. Keep all areas of work clean, neat and orderly at all times.
- B. Clean up and remove all deleterious materials and debris from the entire work area prior to Final Acceptance.

3.12 FINAL REVIEW

- A. Final Review under this Section shall be performed upon completion of the Landscape Establishment Period. Refer to Section 32 9813 "Landscape Establishment Period" for requirements under this section.

END OF SECTION

SECTION 329400 - LANDSCAPE PLANTING ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete exterior Landscape Planting Accessories installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Mulches (wood products).
 - 2. Root Control Barriers.
 - 3. Stakes and Guys.
 - 4. Vine Trellis Support System.
 - 5. Erosion Control Materials.
 - 6. Landscape Edgings (Headers/Edgings/Mow strips).
 - 7. Miscellaneous Materials (Herbicides, Vitamin Stimulant/Root Hormone, etc.).
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 31 2219 "Landscape and Fine Grading".
 - 3. Section 32 1500 "Aggregate Surfacing".
 - 4. Section 32 8400 "Planting Irrigation".
 - 5. Section 32 9200 "Lawns and Grasses".
 - 6. Section 32 9300 "Trees, Shrubs, Vines, and Groundcovers".
 - 7. Section 32 9813 "Landscape Establishment Period".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM - American Society for Testing and Materials.
 - 2. ANSI - American National Standards Institute.
- B. Measurements:
 - 1. PSI: Measurement, in pounds per square inch.
 - 2. CU/FT: Measurement, in cubic-foot.
 - 3. PPM: Measurement, in parts per million.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Product/Material Data. Submit available product/material literature (including color charts) supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material.
- H. Material Samples: For each type of material specified herein, provide Material Samples for review by the Landscape Architect. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled plastic bags (as applicable):
 - 1. 0.50 cubic foot of Landscape Mulch Material (Shredded Wood Mulch).
 - 2. One (1) two-foot (2'-0") long sample of Root Control Barrier.
 - 3. One (1) set of Tree Tying/Staking Materials for each type used, as applicable.
 - 4. One (1) set of Tree Guying Materials for each type used, as applicable.
 - 5. One (1) two-foot (2'-0") length of Vine Support Tape, and one (1) Vine Support Anchor, as applicable.
 - 6. One (1) two-foot (2'-0") square sample of Erosion Control Material for each type used, as applicable.
 - 7. One (1) two-foot (2'-0") sample of Landscape Edging Materials and Accessories (stake, etc), to verify gauge, size, and color selected, as applicable.
- I. Scaled Shop Drawings: Not Required.

- J. Field-Constructed Mock-ups: Not Required.
- K. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Landscape Planting Accessories installations.

1.4 QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications:
 - 1. Engage an experienced Installer who has completed Landscape Planting Accessories work similar in material, design, and extent to that indicated for this Project and with a record of successful installation.
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that installations under this Section are in progress.
- B. Observation: Landscape Architect may observe installation of Landscape Planting Accessories at Project Site for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Landscape Planting Accessories for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected Accessories immediately from Project site.
- C. Manufacturer's Directions: Follow Manufacturer's directions and drawings in cases where the Manufacturers of articles used in this Section furnish directions covering points not shown in the Contract Drawings and Contract Specifications.
- D. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, testing services, and inspections necessary to perform and complete Work under this Section.
- E. Single-Source Responsibility: Obtain each color, type, and variety of products/materials from a single source with resources to provide products/materials of consistent quality in appearance and physical properties without delaying Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide new, unused materials indicated under this Section. Store and secure properly to prevent theft or damage. Deliver and store perishable material in original, unopened packaging. It is the responsibility of the Contractor to install "factory condition" Units.
- B. Damaged Materials: Be responsible for all damage or disfiguration of Work until Final Acceptance. Remove off site and replace at no additional cost to Owner all damaged or rejected materials.
- C. Deliver materials so as to not delay Work, and install only after preparations for installation have been completed.

1.6 COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to installing Landscape Planting Accessories are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease installation operations and notify Landscape Architect for further direction.
- C. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.
- D. Installation: Perform installation of Landscape Planting Accessories only when weather and soil conditions are suitable in accordance with locally accepted practices.
- E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

1.7 SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.

1.8 LANDSCAPE ESTABLISHMENT PERIOD

- A. Refer to Section 32 9813 "Landscape Establishment Period", for requirements under this Article.
 - 1. During the duration of the Landscape Establishment Period, continuously maintain Landscape Planting Accessories by tightening, holding plumb, and/or repairing Staking

and/or Guying supports, providing adequate depths and coverage requirements of Landscape Mulching Materials, monitoring drainage within Tree Root Aeration Units, hold Edging Materials true and in proper alignments, and other requirements, as required, to establish healthy, viable landscape planting materials until Final Acceptance of Work is granted.

PART 2 - PRODUCTS

2.1 LANDSCAPE MULCH MATERIALS

- A. Aggregate Mulch: Refer to Section 32 1500 "Aggregate Surfacing"
- B. Shredded Wood Mulch: Shredded Wood Mulch, free from deleterious materials, debris, and weed seed. Suitable as a top dressing of trees, shrubs and groundcovers, consisting of following:
1. Type: Shredded cedar, redwood, fir, or hardwood commercial wood bark or shredded cypress mulch products. Shredded Wood Mulch shall be graded and to average dimensions of one-inch (1") to three-inches (3") in length, and flat in cross-section.
 - a. Minimum organic matter content at 80%.
 - b. pH between 5.0 and 8.0.
 - c. Salt content shall be less than 4 millimho/cm @ 25 ° C. on a saturated paste extract.
 - d. Boron content of the saturated extract shall be less than 1.0 parts per million.
 - e. Calcium carbonate shall not be present.
 - f. Carbon:Nitrogen ratio is less than 100:1.
 - g. Compost shall be aerobic without malodorous presence of decomposition products.
 - h. Maximum particle size shall be 2 inches. A maximum of 5% shall pass a No. 2 screen.

Maximum Total Permissible Pollutant Concentrations (in parts per million (PPM)) on a dry weight basis:	
Arsenic	20 ppm
Molybdenum	30 ppm
Cadmium	15 ppm
Nickel	50 ppm
Chromium	150 ppm
Selenium	25 ppm
Cobalt	50 ppm
Silver	10 ppm
Copper	150 ppm
Vanadium	50 ppm
Lead	150 ppm
Zinc	150 ppm
Mercury	10 ppm

2. Coverage depth:

- a. Refer to Part III indicated herein this Section.

2.2 ROOT CONTROL BARRIERS

A. Plastic Root Control Barrier:

1. General: Plastic Root Control Barrier shall be a long-term root control system for trees, fully permeable to oxygen and water to sustain and direct plant growth. Plastic Root Control Barrier shall be manufactured of an extruded, high-impact black homo-polymer (polyethylene or polyolefin) plastic, with minimum 50% post-consumer recycled material, and UV inhibitors. Plastic Root Control Barrier shall be composed of a system consisting of a series of integrally-molded, self-interlocking Barrier Panels. Polystyrene-based plastic is unacceptable.
 - a. Size: Each panel shall be a minimum of twenty-four-inches (24") in width and thirty-six-inches (36") in depth, extruded to a mean thickness of .08 inches, with $\frac{1}{2}$ " to $\frac{3}{4}$ " raised vertical ribs running perpendicular to the panel and spaced six-inches (6") on-center. Provide quantity as required of integrated interlocking joint panels, in lengths as required.
 - b. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) UB-36-2 Deep Root, Deep Root Partners, San Francisco, CA, 800-458-7668.
 - 2) Root Solutions, Vespro, Inc., San Rafael, CA, 800-554-0914.
 - 3) Dual Purpose Panels, .080 Thickness, Villa Root Barrier, Inc. Lake Elsinore, CA, 800-654-4067.
 - 4) RP Series Root Barrier Panel, NDS, 800-726-1994.
 - 5) CP Series Root Barrier Panel, Century Products USA, 714-632-7083.
 - 6) Or equal, as approved by the Landscape Architect.

2.3 STAKES AND GUYS

A. Tree Staking and Guying Application:

1. For trees less than 3" in caliper size in planting or lawn areas, use "At Grade Tree Staking Application" by manufacturer and size or product number noted below.
2. For trees 3.5" to 6" in caliper size in planting or lawn areas, use "Below Grade Tree Staking Application" by manufacturer and size or product number noted below.
3. For trees 3.5" to 6" in caliper size in hardscape planting pits, tree wells or similar use "Below Grade Tree Staking Application" by manufacturer and size or product number noted below.
4. For trees 6" to 10" in caliper size use "Below Grade Tree Support Root Guying System" by manufacturer and size or product number noted below.
5. For trees 10" and larger use "Below Grade Tree Support Root Guying System" by manufacturer and size or product number noted below.
6. For trees on structure use "Below Grade Tree Support Root Guying System" by manufacturer and size or product number noted below unless soil depths are greater than six-foot overall than use methods noted above from sections 2.3.A.1 through 2.3.A.5.
7. Above grade staking systems are not allowed unless approved by Landscape Architect prior.

- B. Tree Staking and Guying Hardware or Systems
 - 1. At Grade Tree Support Staking System.
 - a. Pre-assembled, pre-packaged, tree anchoring system, specifically manufactured to anchor trees in a primary at-grade application. System components (sized accordingly to tree caliper) include main support root ball bar system, below grade anchors (rod driven) or stakes and wire or nylon rope and attachment hardware.
 - b. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) Root Anchor at Grade Tree Staking by Tree Stake Solutions, LLC, www.treestakesolutions.com for distributors.
 - 2) Or approved equal by Landscape Architect.
 - c. Product Application:
 - 1) For trees up to 2" caliper, Root Anchor 45/65 BG or smaller by Tree Stake Solutions or approved equal.
 - 2) For trees 2.5" – 4" caliper, Root Anchor 100/150 BG or smaller by Tree Stake Solutions or approved equal.
 - 3) For trees 4.5" – 6" caliper, Root Anchor 200/300 BG or smaller by Tree Stake Solutions or approved equal.
 - 2. Below Grade Tree Support Staking System.
 - a. Pre-assembled, pre-packaged, tree anchoring system, specifically manufactured to anchor trees in a primary at-grade application. System components (sized accordingly to tree caliper) include main support anchor rod and top cap anchor.
 - b. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) Arbor Stakes Tree Staking by Arbor Stake, LLC, www.arborstakes.com for procurement.
 - 2) Or approved equal by Landscape Architect.
 - c. Product Application:
 - 1) For trees up to 3" caliper, use (3) Arborstake assemblies evenly distributed per manufacturer or approved equal.
 - 2) For trees 4" and larger, use (3) Arbostake assemblies plus (1) additional per each additional caliper inch above 3" evenly distributed per manufacturer or approved equal.
 - 3. Below Grade Tree Support Root Guying System (complete below grade application).
 - a. Pre-assembled, pre-packaged, tree anchoring system, specifically designed and manufactured to hold the tree's root ball in place, with only the tree protruding from the ground. System components (sized accordingly to tree caliper) include anchors, wire rope, turn buckles, tree collars, and wire rope clamps.
 - b. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) Duckbill Tree Anchor System, Foresight Products, LLC, 6430 E. 49th Drive, Commerce City, CO 80022, 800-325-5360.
 - 2) Or equal (no known equal).
 - c. Product Application:
 - 1) For trees up to 4" caliper, Duckbill Tree Anchor System #68RBK.
 - 2) For trees larger than 4.5" caliper, Duckbill Tree Anchor System #88RBK.

- C. Supports for Vines:
1. Vine Supports: Galvanized metal or plastic epoxy-fastening type, as accepted.
 2. Vine Tie Tape: Polyethylene tape, ½" wide.

2.4 EROSION CONTROL MATERIALS

- A. Open Weave Jute Fiber Mesh: Biodegradable, woven, 100% natural jute fiber yarn, +/- 0.25" thick, un-dyed and unbleached, 0.92 lbs. per sq. yd. minimum, with 50% to 65% open area. Provide "U"-shaped, 11-gauge steel wire staples, six-inches (6") to eight-inches (8") long, 2" crown, to anchor Jute Fiber Mesh to soil surface.
1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Anti-Wash/Geojute, Belton Industries, Inc.
 - b. Or equal, as approved by the Landscape Architect.
 2. Provide on slope gradients 4:1 and greater
- B. Rolled Erosion Control Blanket: 95-100% organic biodegradable materials, consisting of machine-manufactured 100% certified weed free agricultural straw fibers, 100% natural coconut-fibers (coir), or a combination thereof, evenly distributed over the entire area of the Blanket. Fibers shall be sewn into a medium weight natural fiber, degradable mesh net (top and/or bottom) on on-one-half-inch (1-1/2") centers, with cotton polyester or polypropylene thread. Blanket rolls shall be a minimum of 6'-6" wide, and a minimum of .05 lb./sq. yd. Provide "U"-shaped, 11-gauge steel wire staples, six-inches (6") to eight-inches (8") long, two-inch (2") crown, to anchor Erosion Control Blankets to soil surface.
1. Products & Manufacturer's: Subject to compliance with requirements, provide product(s) as required by one (1) Manufacturer, subject to specific slope gradient conditions indicated per the Contract Drawings, as follows:

Slope Gradient Application	Product Type and Composition	* Acceptable Manufacturers and Manufacturer's Product Reference Numbers			Anticipated Functional Longevity of Product
		Greenfix America, Brawley, CA 760-351-7791	North American Green, Evansville, IN 800-772-2040	Western Excelsior, Mancos, CO 800-833-8573	
3:1 to 2:1 slopes.	70% Straw + 30% Coconut Fibers (Coir); Double Net (Top & Bottom).	#CFS072B	#SC150BN	#NAT-CS-3	18 Months
2:1 to 1:1	100%				

slopes, and greater.	Coconut Fibers (Coir); Double Net (Top & Bottom).	#CF072B	#C125BN	#NAT-CC-4	24 Months

2. * or equal, as approved by the Landscape Architect.

2.5 LANDSCAPE EDGINGS/HEADERS/MOWSTRIPS:

A. Steel Edging/Header:

1. General: Steel Edging/Header shall be in the location and size as shown on the Contract Drawings. Comply with ASTM A569, hot-rolled, standard flexible carbon steel edging, fabricated in sections with stake pockets stamped, punched, or welded to face of sections approximately thirty inches (30") apart to receive stakes. Steel Edging/Header shall be double-staked at overlap joints, and designed to receive tapered steel stakes.
 - a. Size: 3/16" thick, 4" wide, by 16'-0" length, with six (6) stakes per 16' section.
 - b. Size: 1/4" thick, 5" wide, by 16'-0" length, with seven (7) stakes per 16' section.
 - c.
2. Color/Finish: Factory-applied Sherwin Williams H68GT85 powder coat paint, electrostatically applied and oven baked. Minimum thickness to be 1.5 mils.
 - 1) Color: Black.
 - a. Color/Finish: Factory-applied dipped galvanized finish, applied after steel landscape edging is cut to length and stake pockets are stamped, punched or welded. Galvanization shall comply with ASTM A123. Zinc coverage shall be to a standard thickness of 3.3 mil (2.0 oz/ft²).
 - b.
3. Steel Edging/Header Stakes: Steel, tapered, 15-16" minimum length, finish to match specified Steel Edging/Header. Stakes designed specifically to anchor Steel Edging/Header in place, and manufactured by manufacturer of the Steel Edging/Header for which they will be used.
4. Accessories: Standard tapered ends, corners, and splices, as required.
5. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Ryerson & Son, Emeryville, CA.
 - b. Col-met Steel, Collier Metal Specialties, Garland, TX.
 - c. Or equal, as approved by the Landscape Architect.

2.6 MISCELLANEOUS MATERIALS

- A. Water: Per ASTM C94, from potable domestic source, and free from deleterious materials such as oils, acids, and organic matter. Transport as required.
- B. Stress Reducing Agent:
 1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Roots Concentrate, Roots, Inc., Independence, MO.
 - b. Or equal (no known equal).

2. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.
- C. Wetting Agent and Soil Penetrant:
 1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Roots NoBurn®, Roots, Inc., Independence, MO.
 - b. Naiad-SS,
 - c. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.
- D. Herbicides: EPA registered and approved, from the following:
 1. Non-Selective Post-Emergent Herbicide: Spray-applied solution containing a minimum of 41% of the active ingredient "glyphosate" (full strength), with a surfactant, mixed with water accordingly per the Manufacturer's directions.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) Roundup® PRO, (41% glyphosate), Monsanto Company, St. Louis, MO.
 - 2) Roundup® PRO Concentrate (50% glyphosate), Monsanto Company, St. Louis, MO.
 - 3) Honcho® Plus, (41% glyphosate), Monsanto Company, St. Louis, MO.
 - 4) High Yield® Kill-Zall Weed & Grass Killer, (41% glyphosate), Voluntary Purchasing Groups, Bonham, TX.
 - 5) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.
 2. Selective Pre-Emergent Herbicide (Packaged dry material application): Pre-emergent control of annual grasses and broadleaf weeds in turf grass areas, and woody ornamental trees, shrubs, vines, and groundcover areas. Product to contain the active ingredient "trifluralin".
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) Ronstar® 2G, (granular), Aventis Environmental Science USA.
 - 2) Snapshot® 2.5 GT (granular), (2% trifluralin), Dow AgroSciences LLC.
 - 3) Treflan® HFP (43% trifluralin), Dow AgroSciences LLC.
 - 4) Treflan® TR-10, (10% Granular trifluralin), Dow AgroSciences LLC.
 - 5) Surflan®, Dow AgroSciences, LLC.
 - 6) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.
 3. Selective Post Emergent Herbicide: Pre-mixed, flow-able formulation designed for product stability, uniformity in the spray solution and ease of handling. Post-emergent control of annual grasses, nutsedge, and broadleaf weeds in turf, generally with one (1) application.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:

- 1) Trimec® Plus.
 - 2) Ornamec® 170 Grass Herbicide.
 - 3) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.
- E. Plant Vitamin/Hormone Stimulant:
 1. Provide in a diluted liquid solution with water, at the time of watering-in recently planted plant species.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) SUPERthrive, Vitamin Institute.
 - 2) Roots2, Roots, Inc., Independence, MO.
 - 3) Root-Maxx Plus, Bio-Plex, Mt. Joy, PA.
 - 4) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.
- B. Installation practices of the Landscape Planting Accessories shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted horticultural practice, as approved by the Landscape Architect. Contractor shall notify the Landscape Architect, in writing, on the anticipated commencement date and length of duration of the landscape installation.
- C. Examination: Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of Work of this Section. Prior to Work in this Section, Contractor shall examine previously installed Work from other trades and verify that such Work is complete and as required, to the point where the installation of the Landscape Planting Accessories may commence properly.

3.2 PROTECTION OF SITE

- A. Contractor shall protect existing and new improvements and systems installed prior to installation of Landscape Planting Accessories. Maintain protection in place until completion of Work and Landscape Establishment Period.

3.3 INSTALLATION OF ROOT CONTROL BARRIERS

- A. Plastic Root Control Barrier Panels:

1. Verify the location of underground utilities prior to placement of Root Control Barrier Panels.
2. Excavate sub grade to the required depth of the Panel, and install Panels as an interconnected, linear system, with the ribs of the Panels vertically aligned and facing towards the Plant Material's root mass.
 - a. Install Root Control Barrier Panels along the entire perimeter edge for trees located in raised planters (as required).
 - b. Install Root Control Barrier Panels along the entire perimeter edge of the planting area for trees located in parking lots (as required).
 - c. Install Root Control Barrier Panels for trees where the tree trunk is located within a minimum of five-feet (5') of paved surfaces (sidewalks, curbs, plazas, etc).
 - 1) Root Control Barrier Panels shall extend a minimum of ten-feet (10') from either side of the tree trunk, and follow along the profile of the paved surface being protected. Install Panels at a maximum of four-inches (4") to six-inches (6") from the edge of the paved surface.
 - d. Install Root Control Barrier Panels in specific locations as indicated on the Contract Drawings.
3. Install Root Control Barrier Panels plumb, or if conditions allow, with the top of the Panel slightly inclined towards the root mass. DO NOT install with the top inclined away from the root mass.
 - a. DO NOT install Root Control Barrier Panels in a circular pattern that encloses the root mass, thus restricting future growth of the Plant Material's root system.
4. Set top of the Root Control Barrier Panels at the finish graded surface, just below the mulch layer. Install per the requirements of the Manufacturer.

3.4 STAKING AND GUYING

- A. General: Tree Staking and Tree Guying shall be per the direction of the Landscape Architect. Staking and/or guying of trees shall be completed immediately following tree planting operations.
 1. Contactor shall provide new Tree Stake or Tree Guy assemblies; reconditioned or previously-used Tree Stake or Tree Guy assemblies shall not be permitted. Provide one (1) set of Tree Staking materials or Tree Guying materials per tree, as required. Trees shall remain plumb and straight from installation through the Contractor Warranty period. Staking and Guying assemblies shall remain the property of the Owner.
- B. Staking/Guying Methodology: Unless otherwise directed on the Contract Drawings or as directed by the Landscape Architect based on field conditions, provide the tree staking type and quantity noted in Section 2.2 above.

3.5 INSTALLATION OF EROSION CONTROL MATERIALS

- A. Clear away trash, large stones, and other debris. Prepare sub grade; fine grade area to receive Erosion Control Material, eliminating footprints, tracks, and ruts.
- B. Sequences: For hydroseed applications, install the seed slurry prior to installing the Erosion Control Material. In applications where rooted stock is planted on the slope, care shall be exercised to prevent disruption or damage to the underlying material.

- C. Unroll Material as close as possible to its intended final position to minimize the need to drag the Material which would dislocate underlying materials or disturb the prepared sub grade or planting. Install Material flush and completely in contact with the ground. Confirm that there is no tension on the Material to minimize soil contact.
- D. Overlap Material at a minimum of four-inches (4") on the sides and eighteen-inches (18") on the ends. Staples shall be inserted at intervals no greater than three-feet (3') on-center along overlaps and down the center of each roll length.
- E. Joining rolls of the Material shall be installed at the down-channel end of the installed roll, which should overlap the up-channel end of the roll being installed. Overlap should be a minimum of eighteen-inches (18"). Equally set staples on twelve-inch (12") on-center spacing.
- F. Anchor slot at top of slope shall be installed by burying up-channel end in a six-inch (6") minimum deep trench. Equally set staples on twelve-inch (12") on-center spacing.
- G. On slopes less than six-feet (6') in height, Material may be installed with roll perpendicular to the contours.
- H. The terminal fold shall be installed by bringing the Material down to the level area before terminating. Turn the end under a minimum of six-inches (6"). Equally set staples across the fold at twelve-inch (12") on-center spacing.

3.6 INSTALLATION OF LANDSCAPE EDGINGS (HEADERS/EDGINGS/MOWSTRIPS)

- A. General: Install in location(s) in solid undisturbed soil, or in soil set at ninety-percent (90%) relative compaction, at areas as indicated on the Contract Drawings.
 - 1. Horizontal Alignments:
 - a. Straight Alignments: Where indicated on the Contract Drawings, install Landscape Edgings in straight/angular sections, true to the alignments as indicated, free of "wiggles" or bends, using strings as guides.
 - b. Curved Alignments: Where indicated on the Contract Drawings, install Landscape Edgings in curved,/radial sections, true to the alignments as indicated, free of "wiggles" or bends, following marked alignments as reviewed in the field by the Landscape Architect.
 - 2. Vertical Alignments: Install parallel to and following along the contoured finished grade.
 - 3. Refer to the Manufacturer's latest printed instructions and Contract Drawings for requirements of Landscape Edgings/Headers fabricated from metal materials.

3.7 MULCHING

- A. General: Mulch backfilled surfaces of pits, trenches, planted areas, and other areas indicated.
- B. Shredded Wood Mulch:
 - 1. General: Verify locations to receive Shredded Wood Mulch.
 - 2. Apply the following average thickness of Shredded Wood Mulch, and finish level with adjacent finished surfaces. Do not place Shredded Wood Mulch directly against trunks

or stems of Plant Materials. Remove Shredded Wood Mulch that is placed against the growing bases or within the basal nodes of plants.

3. Thickness/Depth: Three-inches (2"), minimum.
4. While settlement and/or decomposition of the Shredded Wood may occur during the duration of the Contract, the Shredded Wood Mulch thickness as indicated shall be consistent throughout the duration of the Contract. The Contractor shall provide additional Shredded Wood Mulch, as needed, and as directed by the Landscape Architect, to maintain the specified constant thickness of the Shredded Wood Mulch, until Acceptance of Work is granted.

C. Aggregate Surfacing:

1. Refer to Section 32 1500 "Aggregate Surfacing" for installation requirements.

3.8 INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Anti-Desiccant: Apply using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.
 1. When deciduous trees or shrubs are moved in full-leaf, spray with anti-desiccant at nursery before moving and again two (2) weeks after planting.
- B. Stress Reducing Agent: Apply, as required and directed by the Landscape Architect, per Manufacturer's latest printed instructions.
- C. Wetting Agent & Soil Penetrant: Apply, as required and directed by the Landscape Architect, per Manufacturer's latest printed instructions.
- D. Herbicides: Apply, as required and directed by the Landscape Architect, per Manufacturer's latest printed instructions.
- E. Plant Vitamin/Root Stimulant: Apply, per the Manufacturer's latest printed instructions. Refer to application requirements per Section 329300 "Trees, Shrubs, Vines and Groundcovers".

3.9 CLEAN UP AND PROTECTION

- A. For Work under this Section, keep Work area in a clean, orderly, and safe condition. Contractor shall remove trash caused from his Work on a weekly basis throughout the duration of the Work.
- B. Protect landscaping from damage due to landscape operations, operations by other Contractors and trades, and trespassers. Maintain protection during installation and landscape establishment periods. Treat, repair, or replace damaged Landscape Planting Accessories as directed.
- C. Upon completion of his Work under this Section, the Contractor shall remove rubbish, waste, debris, excess construction materials, and other items resulting from construction operations offsite as described herein this Section and directed by the Landscape Architect.

3.10 FINAL REVIEW

- A. Final Review under this Section shall be performed upon completion of the Landscape Establishment Period. Refer to Section 32 9813 "Landscape Establishment Period" for requirements under this section.

END OF SECTION

SECTION 329813 - LANDSCAPE ESTABLISHMENT PERIOD

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Landscape Establishment Period, as specified during progress of the Work, after installation, for a designated period, as shown in the Contract Drawings (if any), and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Establishment of Landscape Installation, for a given duration as specified herein this Section.
 - 2. Monitoring, maintenance, adjustment and repair of irrigation.
 - 3. Hand and supplemental watering of plantings
 - 4. Mowing, edging and trimming of lawn areas.
 - 5. Pruning and trimming of trees and shrubs.
 - 6. Weed control and weeding of all planted areas.
 - 7. Application of fertilizers, insecticides, and herbicides.
 - 8. Surface raking or leveling maintenance of aggregate surfacing.
 - 9. General site cleanup; removal of trash and products of maintenance.
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 31 22 19 "Landscape and Fine Grading".
 - 3. Section 32 15 00 "Aggregate Surfacing".
 - 4. Section 32 84 00 "Landscape Irrigation System".
 - 5. Section 32 91 13 "Soil Preparation".
 - 6. Section 32 92 00 "Turfs, Native Grasses and Wildflower".
 - 7. Section 32 93 00 "Landscaping".

1.2 DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. USDA – United States Department of Agriculture.
 - 2. ASTM – American Society for Testing & Materials.
 - 3. ANSI – American National Standards Institute.
 - 4. ISA – International Society of Arboriculture.
- B. Standards:
 - 1. American National Standard for Tree Care Operation, Tree, Shrub, and Other Woody Plant Maintenance (ANSI A300), American National Standards Institute, Latest Edition.

2. American National Standard for Tree Care Operations (ANSI Z133), American National Standards Institute, Latest Edition.
3. Tree Pruning Guidelines, International Society of Arboriculture, 1995 Edition.
4. Pruning Standards for Shade Trees, National Arborists Association, Latest Edition.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Quality Control Submittals:
 1. Schedule of maintenance operations and monthly status report including list of equipment, materials proposed for the job (and watering schedule).
 2. Licenses, permits and insurance required by the City of Westlake, the State or Federal government pertaining to maintenance work.
 3. Monthly record of all herbicides, insecticides and disease control chemicals used for the project.
 4. Final landscape establishment report documenting specific changes or modifications to the plants or irrigation and incidents of pest or insect infestation controls that had been required to properly maintain and insure the continued vigor of the planting.
 5. Documentation of existing planting and irrigation system.
 6. Written application recommendation by a licensed agricultural pest control advisor for all weed, pest and disease controls restricted by the Director of Agriculture proposed for this work.
- H. Project Close-out Submittal: Include in a single, 3-ring binder a landscape maintenance manual containing an indexed collection of all schedules, records and permits listed above, as well as a documentation of accepted condition of planting and irrigation at Final Acceptance.

1.4 QUALITY ASSURANCE AND CONTROL

A. Qualifications:

1. Experience: The landscape contractor or maintenance subcontractor shall have a full-time employee assigned to the job as foreman for the duration of the contract. He/she shall have a minimum of four (4) years experience in landscape maintenance supervision, with experience or training in turf management, entomology, pest control, soils, fertilizers and plant identification.
2. Labor Force: The landscape maintenance labor force shall be thoroughly familiar with, and trained in, the work to be accomplished and shall perform the task in a competent, efficient manner acceptable to the Owner.

B. Requirements:

1. Supervision: The foreman shall directly supervise the work force at all times. Notify Owner of all changes in supervision.
2. Identification: Provide proper identification at all times for landscape maintenance firm's vehicles and labor force. Be uniformly dressed in a manner satisfactory to the Owner.

1.5 PROJECT/SITE CONDITIONS

- A. Site Visit: At beginning of maintenance period, visit and walk the site with the Owner's representative to clarify scope of work and understand existing project/site conditions.
- B. Documentation of Conditions: Document general condition of existing trees, shrubs, vines, groundcovers and lawn recording all plant materials which are healthy, thriving, damaged, dead or dying.
- C. Irrigation System: Document general condition of existing irrigation system, making sure that faulty electrical controllers, broken or inoperable sprinkler heads (or emitters) are reported.

1.6 SEQUENCING AND SCHEDULING

- A. Perform all maintenance during hours mutually agreed upon between Owner and Contractor.
- B. Work force shall be present at the project site at least once a week and as often as necessary to perform specified maintenance in accordance with the approved maintenance schedule.

1.7 CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall begin maintenance after any portion of the sprinkler irrigation, each plant and lawn portion is installed.
- B. Sprinkler Irrigation System: The Contractor's maintenance of the sprinkler irrigation system shall consist of monitoring and adjustment of valves, repair of leaks in both mains and lateral lines and all other work required to establish a complete working irrigation system.
- C. Trees, Shrubs, Groundcovers and Vines: The Contractor's maintenance of new planting shall consist of watering, cultivating, weeding, mulching, re-staking, tightening and repairing of guys, resetting plants to proper grades or upright position, restoration of the planting saucer, and furnishing and applying such sprays and invigorants as are necessary to keep the plantings free of insects and disease and in thriving condition.

- D. Lawns and Meadows;
 - 1. The Contractor's maintenance of grass areas shall consist of mowing and edging of lawn and turf areas.
 - 2. Work in all grass areas including meadow grasses shall include watering, weeding, repair of all erosion and reseeding and resodding as necessary to establish a uniform stand of the specified grasses.
 - 3. Edges of meadows shall be trimmed to keep grasses from blocking walk way edges.
- 1.8 PROTECTION: Protect planting areas and lawns at all times against damage of all kinds for duration of maintenance period. Maintenance includes temporary protection fences, barriers and signs as required for protection. If any plants become damaged or injured, because sufficient protection was not provided, treat or replace as directed by Owner at no additional cost to Owner.
- 1.9 DURATION: Work under this Section shall commence upon the date specified or noted as acceptance in the Substantial Completion Certificate or the Site Substantial Completion Certificate (if separate certifications) and shall occur for a minimum of ninety (90) work days or until Final Acceptance by Landscape Architect, whichever is longer.
- 1.10 FINAL ACCEPTANCE: Work under this Section will be accepted by Landscape Architect upon satisfactory completion of all work, including maintenance, but exclusive of the required guaranteed sprinkler irrigation obligations, replacement of plant materials and lawns under the Warranty Period. Upon Final Acceptance, the Owner will assume responsibility for maintenance of the work.
- 1.11 MAINTENANCE INSTRUCTIONS: At the completion of work, furnish three (3) copies of documented maintenance events and adjustments or changes required by specific plant or site conditions to Owner to enable the contractor and owner to incorporate those items in the maintenance program for the project.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. Materials required for installed items shall match those already in use.
 - B. Samples of all materials not specified under other Sections of these Specifications shall be submitted for review by Landscape Architect prior to use.
- 2.2 REQUIRED EQUIPMENT
 - A. Contractor shall furnish the all necessary maintenance equipment.
- 2.3 WATER: Clean, potable and fresh, as available from Owner.

2.4 FERTILIZERS

- A. Tightly-compressed, slow-release and long-lasting complete fertilizer tablets bearing manufacturer's label of guaranteed analysis of chemicals present.
 - 1. Balanced, once-a-season application, controlled-release fertilizers with a blend of coated prills which supply controlled-release nitrogen, phosphorus and potassium, and uncoated, rapidly soluble prills containing nitrogen and phosphorus.

2.5 HERBICIDES, INSECTICIDES, AND FUNGICIDES

- A. Best quality materials with original manufacturers' containers, properly labeled with guaranteed analysis.
 - 1. Use non-staining materials.

2.6 ANNUALS/PERENNIALS

- A. Nursery-grown in 4-inch pots, full, healthy plants just ready to bloom.

2.7 LAWN SOD AND TURF OR MEADOW GRASS SEED AND SEED MIXES

- A. For sod and seed replacement:
 - 1. Match existing materials.

2.8 REPLACEMENT TREE GUYS, STAKES, TIES AND WIRES

- A. Match originally accepted existing materials on the site.

2.9 EQUIPMENT

- A. General: Use only the proper tool for each job. Maintain all tools in sharp, properly-functioning condition. Clean and sterilize pruning tools prior to usage.

2.10 INSECT/DISEASE PREVENTION

- A. Take all measures to prevent introduction of insect or disease-laden materials onto the site.

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.

3.2 PREPARATION

- A. Protection:
 - 1. Protect all new planting areas from damage of all kinds from beginning of work until sufficiently established or until Final Acceptance.

2. Provide temporary protection fences, barriers and signs as required for protection.

B. Replacements:

1. Immediately treat or replace all plants which become damaged or injured as a result of Contractor's operations or negligence, as directed by Landscape Architect, at no cost to Owner.
2. Replacement plants shall match size, condition and variety of plants replaced.

3.3 WATERING

- A. It shall be the responsibility of the Contractor to assure that the correct watering of plant materials is achieved by supplemental watering as required. Where there is no automatic irrigation and when ever rainfall is not providing adequate water, the contractor is responsible for supplemental watering until the end of the establishment period.
- B. Provide regular and supplemental deep watering to all landscape until the plant material has become established and new growth is apparent. Deep watering shall be accomplished with hoses and sprinklers as permitted.
- C. Frequent watering to the lawn areas to insure against drying. This may be accomplished as above, by the existing automatic sprinkler system, hand watering or portable sprinklers. Contractor shall monitor settings of automatic sprinkler controls and recommend necessary adjustments according to climatic changes.
- D. Contractor shall not be responsible for watering all new planting areas beyond the end of the landscape establishment period.
- E. Contractor shall be responsible for damages to irrigation system and for repair costs caused by operation of equipment or by mowing and other maintenance operations.

3.4 WEED CONTROL

A. General:

1. All planting, turf, grass and meadow grass areas shall be maintained in a weed free condition throughout the landscape establishment period.
 - a. Apply pre-emergent weed control to shrub, groundcover and annual or perennial plantings at the rates specified by the manufacturer. If plant types are not within manufacturers label guidelines for safe pre-emergent application, weed by hand.
 - b. Apply selective and non-selective herbicides per manufacturers label to eliminate weeds in lawn areas.
2. Reference other sections of this specification for additional weed control requirements.

3.5 MAINTENANCE OF TURF AREAS

A. Watering:

1. Water lawns at such frequency as weather conditions require, to replenish soil moisture to 6 in. below root zone. Maintain optimum water availability in the root zone without erosion or over saturation of the soil.

2. Generally, provide initial daily watering to maintain soil moisture in an optimum condition and to promote rapid germination and establishment. After root and top growth has established (approximately 2 weeks, reduce water rate to a total of 1-1/2 in. of water weekly during hot summer weather, in three (3) applications per week after turf or meadow is established.
 3. Water at night if irrigation system is electrically controlled. Otherwise, watering shall be done during early mornings.
- B. Weed Control:
1. Control broadleaf weeds with selective herbicides.
 2. In areas where crabgrass, nut sedge or other invasive weed specie has infested the lawn, apply a selective herbicide as soon as possible, and prior to flowering as recommended by the manufacturer.
 3. Apply pre-emergent herbicides such as Dacthal, Balan, or Betasan prior to invasive grassy weed germination in sodded areas.
 4. Do not irrigate for 48 hours after application of herbicidal sprays or otherwise as recommended by the manufacturer.
- C. Mowing and Edging:
1. Mowing lawn/grass areas shall be accomplished with sharp, properly adjusted mowers of the correct size for the various areas.
 2. Mowing frequency shall be at least one time a week and more often as necessary to keep turf at a height between one and two inches as determined by the specie of turf grass installed.
 3. Lawn shall be edged evenly at all walks, headers and other hard edges not less than once a week.
 4. Mow meadow areas once during early spring to a height of 6 inches, otherwise mow not more than once per season and then only at the specific request of the owner. Generally mowing shall be no lower than 6 inches.
- D. Until the establishment of the turf, the Contractor will be responsible for replacing soils that have eroded onto the paved areas and cleaning of same. Residual soils on paving will be removed and if not mingled with objectionable materials, may be re-used in eroded areas.
- E. Immediately upon observing any lawn grass spreading into shrub or groundcover areas, the Contractor shall initiate a program of mechanical removal and maintain this program throughout the Landscape Establishment period.
- F. Any lawn grass appearing in paved areas shall receive an application of non-selective herbicide according to manufacturer's direction. The herbicide shall be approved and will not be detrimental structurally to paved areas.
- G. Special effort shall be given to the control of fire ants infesting the site. After control is accomplished, the ant mounds shall be lowered and tamped to the existing grade.
- H. Apply slow release fertilizer (24-6-12) forty-five days after installation at 5 pounds per 1000 square feet.
- I. Removal of debris from the site unrelated to horticultural maintenance (paper, bottles, cans, signs, etc.) shall be the responsibility of the landscape establishment Contractor and limited to areas designated. Frequency shall be one time per week during the landscape establishment period.

3.6 MAINTENANCE OF TREES AND SHRUBS

- A. Contractor shall adjust and tighten as required all tree staking and guying. Removal as directed by Owner's Representative.
- B. Resetting: Reset plants to proper grades and upright position by excavating the edge of the plant pit and repositioning the plant to grade. Install backfill and properly compact.
 - 1. Do not use stake guys to straighten trees. Replant to plumb.
- C. Contractor shall deep water all new trees until there are definite signs the trees have established themselves and are pushing out new growth.
- D. Temporary Tree Watering basins shall be removed by Contractor at 60 days from time of planting.
- E. Contractor shall be continuously alert for signs of insect and pest presence or damage or the presence or damage from plant fungi or disease.
 - 1. Disease and pest control shall be the responsibility of the installing contractor until the end of the Landscape Establishment Period. The contractor shall take corrective action within 24 hours of finding the problem or of being notified that there is a pest or disease problem.
 - 2. Upon locating such disease or pest damage, the Contractor shall report it to the Owner's representative and advice of the course of action the contractor will take to eliminate the problem.
- F. Weed Control:
 - 1. All areas between plants, including watering basins, shall be weed free at all times.
 - 2. Use only recommended and legally approved herbicides to control weed growth.
 - 3. Avoid frequent soil cultivation that destroys shallow roots and breaks the seal of pre-emergent herbicides.
- G. Pruning:
 - 1. Prune trees to select and develop permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached, and which have vertical spacing of 18 in. to 48 in. and radial orientation so as not to overlay one another.
 - 2. Prune trees to eliminate diseased or damaged growth, and narrow V-shaped branch forks that lack strength. Reduce toppling and wind damage by thinning out crowns.
 - 3. Prune trees to maintain growth within space limitations, maintaining a natural appearance and balancing crown with roots.
 - 4. No stripping of lower branches ("raising up") of young trees will be permitted.
 - 5. Retain lower branches in a "tipped back" or pinched condition to promote caliper trunk growth (tapered trunk). Do not cut back to fewer than six buds or leaves on such branches. Only cut lower branches flush with the trunk after the tree is able to stand erect without staking or other support.
 - 6. Thin out and shape evergreen trees when necessary to prevent wind and storm damage. Do primary pruning of deciduous trees during the dormant season. Do not permit any pruning of trees prone to excessive "bleeding" during growth season.
 - 7. Prune damaged trees or those that constitute health or safety hazards at any time of year as required.
 - 8. Make all cuts clean and close to the trunk, without cutting into the branch collar. "Stubbing" will not be permitted. Cut smaller branches flush with trunk or lateral

- branch. Make larger cuts (1 in. in diameter or larger) parallel to shoulder rings, with the top edge of the cut at the trunk or lateral branch.
- 9. Branches too heavy to handle shall be precut in three stages to prevent splitting or peeling of bark. Make the first two cuts 18 in. or more from the trunk to remove the branch. Make the third cut at the trunk to remove the resulting stub.
- 10. Do not prune or clip shrubs into balled or boxed forms unless specifically called for by design.
- H. Staking and Guying of Trees:
 - 1. Inspect stakes and guys at least once a month to check for rubbing that causes bark wounds.
 - 2. Repair and replace staking and guying as shown and as specified.
- 3.7 MAINTENANCE OF ANNUALS AND PERENNIALS
 - A. Watering:
 - 1. Hand-water all pre-cast pots and planters without an automatic irrigation system.
 - 2. Species, sizes of plants, container sizes and orientation shall dictate frequency of watering. Submit to Owner a watering schedule for different seasonal requirements.
 - B. Weed Control: All planters with annuals and perennials shall be weed-free at all times.
 - C. Pruning:
 - 1. Limit pruning to removal of damaged or dead twigs and foliage.
 - 2. Remove spent flowers on a weekly basis.
 - D. Replacements of Annuals:
 - 1. Replace annuals when materials exhibit a "spent" condition.
 - 2. Thoroughly cultivate soil after removal of "spent" or "dead" plants prior to planting new materials.
 - E. Fertilization: Incorporate slow release fertilizers per manufacturer's current specifications, and rake smooth.
 - F. Allow for 1 replacement of all annuals during or immediately after the establishment period at no added cost to the owner.
- 3.8 MAINTENANCE OF GROUNDCOVERS
 - A. Watering:
 - 1. Check for moisture penetration throughout the root zone at least twice a month.
 - 2. Water as frequently as necessary to maintain healthy growth of groundcovers.
 - B. Weed Control:
 - 1. All groundcovers shall be maintained in a weed free condition.
 - 2. Control weeds, preferably with pre-emergent herbicides and with selective systemic herbicides.
 - 3. Minimize hoeing of weeds in order to avoid plant damage.
 - C. Fertilization:
 - 1. Recently installed plant materials: Verify with Owner actual completion date of planting installation and rate of prior application of fertilizers.

2. Install slow release 21-6-12 fertilizer except where high phosphorous has been found through soil testing use 21-0-0 ammonium sulfate. Apply at 5 pounds per 1000 square feet.

D. Mowing and Edging:

1. Edge groundcovers to keep in bounds. Trim top growth as necessary to achieve an overall even appearance.

E. Replacements:

1. Replace dead and missing plants according to the warranty requirements.
2. Damages due to Contractor's negligence shall be paid for without charge to Owner.

3.9 INSECTS, PESTS, AND DISEASE CONTROL

A. Inspection: Inspect all plant materials for signs of stress, damage and potential trouble from the following:

1. Presence of insects, moles, gophers, ground squirrels, snails and slugs in planting areas.
2. Discolored or blotching leaves or needles.
3. Unusually light green or yellowish green color inconsistent with normal green color of leaves.

B. Personnel: Only licensed, qualified, trained personnel shall perform required operations for insect, pest and disease control

C. Application: Spray with extreme care to avoid all hazards to any person or pet in the area or adjacent areas.

3.10 IRRIGATION SYSTEM

A. General:

1. Repair without additional charge to Owner all damages to system caused by Contractor's operations. Perform all repairs within one (1) watering period.
2. Report promptly to Owner all accidental damage not resulting from Contractor's negligence or operations.
3. Do not run the irrigation system during rainy season. Set and program automatic controllers for seasonal water requirements.
4. Twice a month, use a probe or other acceptable tool to check the rootball moisture of representative plants as well as the surrounding soil.

B. Cleaning and Monitoring the System:

1. Continually monitor the irrigation systems to verify that they are functioning properly as designed. Make program adjustments required by changing field conditions.
2. Clean pump filter and strainer at least once a year and as often as necessary to keep the irrigation systems free of sand and other debris.
3. Prevent spraying on windows, building walls, (game courts) by balancing the throttle control on the remote control valves and the adjustment screws on the sprinkler heads. Do not allow water to atomize and drift.

C. Winterization: The irrigation system is designed to be completely drained to protect pipe from bursting prior to freezing temperatures. To adequately drain the system, the following procedure must be followed:

1. Air blow-out
 - a. Set automatic control stations to 2-1/2 minutes timing.
 - b. Attach hose from portable air compressor to 1 in. air inlet installed on main line at backflow preventer.
 - c. Operate compressor at 100 cu. ft. per second at 60-80 PSI.
2. Manual drain valves: Open manual drain valves located at low points on the main line to drain main completely after air blow-out has been completed.
3. Backflow Preventer: Rotate backflow unit at unions and open pet cocks and drain. Reverse operation and tighten unions to resume irrigation.

3.11 START OF LANDSCAPE ESTABLISHMENT AND SUBSTANTIAL COMPLETION

- A. Preliminary Review: As soon as planting is substantially completed according to the construction documents, hold a preliminary review to determine the condition of the work.
- B. Date of Review: Notify Landscape Architect at least five (5) working days prior to anticipated date of review.
- C. Beginning of the Maintenance Period: The Landscape Architect will visit the site and determine the status of substantial completion of the work.
 1. The date for substantial completion will be determined by the owner's representative and the landscape architect. The landscape architect will issue a written report which will state the date Preliminary Acceptance and Substantial Completion to the Contractor.
 2. The report may include items required for correction.
- D. Warranty Dates and Date for the End of the Landscape Establishment Period will be noted in the substantial completion report when substantial completion is granted.

3.12 TERMINATION OF THE MAINTENANCE PERIOD

- A. Final Acceptance Procedure:
 1. Work will be accepted by the Landscape Architect upon satisfactory completion of all work, including the landscape establishment period, but exclusive of replacement of materials under the Warranty Period.
 2. Submit a written request to Landscape Architect for review for Final Acceptance at least five (5) working days prior to anticipated Final Review date, which is at the end of the Maintenance Period.
- B. Corrective Work:
 1. Work requiring corrective action or replacement shall be performed within ten (10) calendar days after the Final Review.
 2. Perform corrective work and materials replacement in accordance with the Drawings and Specifications, and shall be made by the Contractor at no cost to the Owner.
 3. After corrective work is completed, the Contractor shall again request a Final Review for Final Acceptance as outlined above.
 4. Continue maintenance of all landscaped areas until such time as all corrective measures have been completed and accepted.
- C. Conditions for Acceptance of Work at End of Maintenance Period:

1. Each plant shall be alive and thriving, showing signs of growth and no signs of stress, disease, or any other weaknesses.
 2. Replace all plants not meeting these conditions. An additional Warranty Period equal in length to the original shall be commenced for all such plants and planted areas.
- D. Final Acceptance Date: The date on which the Landscape Architect issues a Letter of Final Acceptance. Upon Final Acceptance, the Owner will assume responsibility for maintenance of the work.

3.13 CLEANING

- A. Dispose of all pruned materials, vacuum all lawn clippings and leaves, sweep all walkways and rake smooth all mulched areas.
- B. Remove from the site all containers and evidence of maintenance activities.

3.14 CLOSE OUT

- A. Landscape Maintenance Record: Submit binder to Owner with all documentation and records required and utilized during the maintenance period.
- B. Keys and Identification: Return all keys and identification materials supplied by Owner for the purpose of site access.

END OF SECTION

SECTION 334300 - LANDSCAPE DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Landscape Drainage systems and connections, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - a. Trenching and backfilling.
 - b. Providing and installing all pipe, including joints and fittings, cutting pipe to conform to structures and modifications to existing system.
 - c. Constructing or installing surface basins, area drains and other structures.
 - d. Area drains in paving and planting
 - e. Underdrains and subsurface drainage.
 - f. Subdrainage pipes and fittings
 - g. Drain Mat systems
 - h. Filter fabrics and drainage stone
 - i. Drainage Gravel
- C. Related Documents: The following Documents contain requirements that relate to Work in this Section:
 - a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - b. Division 22 - Plumbing; Stormwater Drainage Sections.
 - c. Division 31 – Earthwork Sections.
 - d. Section 31 22 19 "Landscape and Fine Grading".

1.2 DEFINITIONS

- A. HDPE: High-density polyethylene
- B. PE: Polyethylene plastic.
- C. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS

- A. General: Refer to Division 01 for project submittal requirements and timelines. If provided in hardcopy submittal booklets submit each item in this Article in required copies with three (3) copies for review by Landscape Architect. Two (2) copies shall be returned (one for Owner and one for Contractor) and one copy maintained by Landscape Architect.
- B. Provide two (2) sets of Material Samples for review by the Landscape Architect unless requested otherwise. One set will be returned for use as site/field referee sample and the other shall be maintained by the Landscape Architect.
- C. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- D. Electronic Submittals: Electronic Submittal shall be provided in a single bound file, PDF format preferred, unless otherwise noted in Division 01.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
- G. Product Data: Submit labeled samples, manufacturer's latest catalog cuts and specifications for each specified product. Include submittals for every different item specified in each category. Submit as follows:
 - a. Solid and Perforated pipe: Provide manufacturers literature and data.
 - b. Pipe fabric covering: Provide six inch (6") square sample. Provide manufacturers literature and data.
 - c. Geotextile fabrics: Provide a six inch (6") square sample. Provide manufacturers literature and data.
 - d. Gravel: Provide 1-quart sample with sieve analysis and data for each type specified.
 - e. Area Drains: Provide manufacturers literature and data for each type specified.
 - f. Drain Mat: Provide manufacturers literature and data and a six inch (6") square sample for each type specified.
- H. Compatibility Tests: Verification of permittivity and compatibility of soils with geotextile required for compatibility of filter fabric or drainage mat with soil, refer to Section 32 91 13 "Soil Preparation" for required soil types.
- I. Test data: Submit all laboratory test data of all materials.

1.4 PROJECT/SITE CONDITIONS

- A. Protection of Existing Plants to Remain: No Scope.
- B. Protection of Utilities:
 - a. Provide temporary support and protection of underground and surface utility structures, drains, services and other improvements noted to remain.
 - b. Where grade or alignment of pipe is obstructed by existing utility structures such as conduits, ducts or pipes, permanently support, relocate, remove or reconstruct the obstruction, unless otherwise approved by Landscape Architect.
 - c. Restore all damaged improvements to original condition at no additional cost to Owner.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery: All containerized products shall be delivered to the site in manufacturer's original, unopened, legibly labeled containers. All pipe to be delivered bound securely to prevent damage. Supply items as required to protect and support the products.
- B. Storage: Protect materials from damage, water and rust. Store pipes on beds that are full length of pipe. Protect plastic materials from direct sunlight. Protect plastic materials from direct sunlight unless they are UV stabilized.
- C. Pipe: Cap openings against entry by dust, debris and other foreign matter.
- D. Damaged Materials: Remove all damaged materials and replace at no expense to Owner.

1.6 COORDINATION, SEQUENCING AND SCHEDULING

- A. Drainage panel materials and installation shall be compatible with waterproofing walls below grade.
- B. Concealed Work: Verify locations of existing stubouts to receive landscape area drains. Verify and locate existing pipes and structures to be coordinated with landscape drainage work.
- C. Field Measurements for Lines and Levels: Confirm lines and levels for each drainage system and coordinate with other systems to prevent conflicts and maintain proper clearances.
- D. Notification: Submit to Landscape Architect written notification of all discrepancies in the Drawings or existing conditions which preclude successful installation of landscape drainage work as specified.
- E. Plant Pit Drainage: Coordinate installation of inspection tubes with installer of plant materials. Reference Section 32 93 00 "Trees, Shrubs, Vines and Groundcovers" for requirements under this section.

1.7 FINAL ACCEPTANCE

- A. Review Date: Make a written request for review for Final Acceptance at least five days in advance.
- B. Completion: Work will be accepted upon satisfactory completion of all landscape drainage work.
- C. Responsibility: Upon Final Acceptance, Owner will assume responsibility for maintenance of the work.

1.8 INSTALLER QUALIFICATIONS:

- A. Installer of all materials shall be experienced in performing the work of this section and who has specialized in the installation of the specified products and performed satisfactorily on projects of similar scope to that required for this project.

PART 2 - PRODUCTS

2.1 PRODUCTS PIPE AND FITTINGS

- A. Polyvinyl chloride pipe and fittings PVC 1120, conforming to ASTM D1785-76, sizes as shown on the Drawings.
 - a. Type: ASTM D3034, SDR-35, solid and perforated, belled end, solvent weld.
 - b. Type: ASTM D1785, PVC 1120-1220, Schedule 40, pipes and fittings.
 - c. Perforations: 3/8 in. diameter, 4 in. apart center to center longitudinally, in two rows 120 degrees apart.
 - d. Manufacturer: Lasco, (714) 993-1220.
 - e. Fittings Manufacturer: Dura, Lasco, Sloan or approved equal
- B. Polyethylene:
 - a. Perforated and Non-Perforated Polyethylene Tubing:
 - b. Type: ASTM F405 corrugated tubing and fittings, for less than 10 in. diameter, and ASTM F667 for 10 in., 12 in. and 15 in. diameters.
 - c. Manufacturer: Advanced Drainage Systems, Inc., (800) 742-1933.
 - d. Joints: Couplings and fittings as manufactured by ADS.
 - e. Manufacturer: Advanced Drainage Systems, Inc. (ADS), Madera, CA. Tel. (800) 733-1993.
- C. Cleanouts:
 - a. Hardscape Areas: No Cleanouts shall occur in hardscape areas unless approved by Landscape Architect.
 - b. Planted Areas:
 - c. Type: ASTM D1785, PVC 1120, Schedule 40 riser with Schedule 40 adapter and MIP plug.
 - d. Size: Per drawings. Prime with PVC primer and paint exposed portion flat black.

2.2 DRAINAGE STRUCTURES AND DEVICES

- A. General:
 - a. Drainage structures shall be constructed where and as shown in Drawings. Reference Civil for additional requirements.
 - b. Provide and install all fittings and adapters as required for Storm Sewer connections from drainage devices and structures to the terminus of piping.
- B. Hardscape Surface Area Drains
 - a. Type: Refer to Contract Plan Drawings.
 - b. Installation: Refer to Contract Plan Drawings.
- C. Groundcover and Planting Surface Areas
 - a. Type: Atrium style, Refer to Contract Plan Drawings
 - b. Installation: Refer to Contract Plan Drawings.

2.3 UNDERDRAIN PIPE AND FITTINGS

- A. Material shall be equal to "ADS" Polyethylene tubing with "Drain-Gard" and fittings as manufactured by Advanced Drainage Systems, Ennis, Texas, (214) 875-6991 or approved equal.
- B. Tubing perforations shall be saw slots, longitudinally spaced four (4") inches on center, four (4) rows, and 90 degrees apart.
- C. Spun bonded nylon fabric shall be wrapped fully around tubing coils.
- D. Coordinate threaded connections for penetrations through metal planter skins.

2.4 ACCESSORIES

- A. Sand Backfill: Fine granular material naturally produced by the disintegration of rock, sufficiently free of organic material, mica, loam, clay and other deleterious substances to be thoroughly suitable for pipe bedding.
- B. Drainage Gravel: Clean washed gravel 3/8" inch to 3/4" inch, no fines. Crushed stone or presence of fines shall be rejected.

2.5 PERMEABLE BACKFILL

- A. Reference the Civil Engineer or Soils Engineer contract documents and recommendations.

2.6 IMPORTED STRUCTURAL BACKFILL: Reference Civil or Structural Engineer contract documents and recommendations.

2.7 GEOTEXTILES AND DRAIN MAT

- A. Filter Fabric on grade: "Mirafi FW402" woven geotextile. TenCate Geosynthetics Americas, 365 South Holland Drive: Pendergrass, GA 30567; Telephone 706 693 2226. Or approved equal by Landscape Architect matching specifications of noted product.
- B. Drain Matt: CCW MiraDRAIN 9000, poly core with woven filter fabric. Carlisle Coatings & Waterproofing Incorporated; 800-527-7092. Or approved equal by Landscape Architect matching specifications of noted product.
- C. Drain fabric on structure: Mirafi FW402. TenCate Geosynthetics Americas, 365 South Holland Drive: Pendergrass, GA 30567; Telephone 706 693 2226. Substitution not permitted. Or approved equal by Landscape Architect matching specifications of noted product.
- D. Seal for drain mat and fabric: Type of tape that will adhere to the polyethylene fabric. Equivalent to specialty glazing tape such as Sure Tape or equivalent premium duty, flexible, matte finish, red color vinyl coated seal tape.

2.8 SUBDRAINAGE MATERIALS:

- A. Filter Fabric:
 - a. "Mirafi FW402" woven geotextile. TenCate Geosynthetics Americas, 365 South Holland Drive: Pendergrass, GA 30567; Telephone 706 693 2226; Web www.tencategeo.us.com.
 - b. "Terra Tex EP-12" woven geotextile. Hanes Geo Components, 815 Buxton Street, Winston Salem, NC 27101; Telephone 888-239-4539; Web www.HanesGeo.com.
 - c. Or approved equal by Landscape Architect.
- B. Drainage Stone: Clean washed gravel 3/8" inch to 3/4" inch, no fines. Crushed stone or presence of fines shall be rejected.

PART 3 - EXECUTION

3.1 GENERAL

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.
- B. Existing Utilities: Where grade or alignment of pipe is obstructed by existing utility structures such as conduits, ducts or pipes, permanently support, relocate, remove or reconstruct the obstruction.

- C. Deviations: Make no deviations from specified line or grade without written acceptance of change by Landscape Architect.
- D. Verification: Verify rim elevations of area drains relative to adjacent paving prior to beginning of work.

3.2 EXAMINATION

- A. Verification of Conditions: Verify exact locations and quantity of all drains relative to planting areas and adjacent to and within paving, prior to beginning of work. Identify required lines, levels, contours, and datum. Immediately report to Landscape Architect all discrepancies found prior to installation of drains.
- B. Deviations: Make no deviations from specified line or grade without written acceptance of change by Landscape Architect.

3.3 GENERAL INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout shall take design considerations into account. Install piping as indicated, to extent practical.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow piping and connect to building or site storm drains, of sizes and in locations indicated. Terminate piping as indicated.
 - a. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 - b. Install piping with cover per the drawings

3.4 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to installations indicated.
- B. PE Pipe and Fittings: As follows:

- a. Join pipe, tubing, and fittings with couplings for soil tight joints according to manufacturer's written instructions.
 - b. Install according to ASTM D 2321 and manufacturer's written instructions.
 - c. Install corrugated piping according to the Corrugated Polyethylene Pipe Association's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."
- C. PVC Sewer Pipe and Fittings: As follows:
- a. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
 - b. Install according to ASTM D 2321.

3.5 DRAINAGE MATTING:

- A. General:
- a. Review: Do not install drainage matting prior to acceptance of concrete work and Owner or General Contractors acceptance, testing and approval of waterproofing under another Section is completed.
 - b.
 - c.
 - d.
 - e.
 - f. Coordination: Insure soil and pavement covering is staged to be accomplished within a maximum of 7 days of installation. 5 days is preferred. Allow review time within the required 5 days. Should the work be a size that would limit time of placing covering, coordinate installation and following covering work in stages, completing installation and covering within the time limit.
 - g. Verify drainage devices to intercept the drain water from the drain mat installation are in place and that the substrate or deck has positive flow to the point of discharge of the drain water.
 - h. Protect adjacent work and finishes from damage during installation of the drain mat.
 - i. Verify walls and decks are monolithic, smooth, free of voids, spalled areas, laitance, honeycombs and wire mesh, differential movement in pre-cast slabs, backer rod and sealant is installed at joints, sharp protrusions are not present and no other items detrimental to the proper installation of the drain mat are present. Notify General Contractor where corrections are required.
 - j. Commencing work shall constitute acceptance of the substrate and site.
 - k. Openings, seams, and penetrations are to be sealed with drainage fabric adhered to drain mat fabric with seal tape.
 - l. Take care to insure no point loads are placed on the drain mat that would puncture the material.
 - m. Manufactures representative and Landscape Architect shall review and approve the installation prior to covering the drain mat.
 - n. Do not use drainage panels as protection over waterproof membrane, unless otherwise approved by waterproofing membrane manufacturer.
 - o. Provide protective backing on the panels if waterproofing could be cut or damaged by the installation. Coordinate with waterproofing installer.

B. Installation:

- a. Horizontal surfaces:
- b. Install with geotextile fabric facing soil. Extend matting to 4 in. from top of planter (or wall). Adhere with MiraStick or equivalent adhesive temporarily until soil or other light resistant covering can be placed on or against the mat. Maintain adhesive and panels with full fabric covering and no exposed seams through the soil installation.
- c. Roll the fabric on the deck with horizontal jointing running perpendicular to the slope of the deck. Abut panels together without overlap of panels. Cut panel portion back where partial panels are to be installed, leaving a minimum of 4" of undamaged fabric serving as a cover lap in place. Cover adjacent panels with the fabric lap, working in the direction of the slope, lapping the fabric over the down hill panel fabric. Shingle the panels in the direction of the slope.
- d. If soil is not immediately available to cover the work, secure the laps onto adjacent panels. Refer to time limits in general item above.
- e. Work in the deck area from low to high points to allow proper shingling. Cut panels and fabric at drainage chimneys and / or inspection tubes. Seal tubes and chimneys with fabric per the details. Provide a continuous panel joint at vertical wall conditions for later covering with the vertical panel. If no vertical panel is to occur, lap fabric around and back under the panel edge.
- f. Vertical Surfaces
- g. Install with geotextile fabric facing soil. Connect adjacent panels at the longitudinal edge by pulling the filter fabric back to expose the panel flange. The panel edge shall be butted to the edge of the adjacent panel. Connections shall be completed in shingle fashion so that moisture will flow with the overlap, not against it. Overlap fabric over adjacent panels and in the direction of water flow.
- h. Leave a 4-inch fabric lap at the bottom of the panel to lap over the deck panel. Cut the top panel 4" below finish grade.
- i. Leave a minimum of 4" of fabric to lap over and behind the panel.
- j. Drains and Penetrations: Cut panels and fabric at drainage chimneys and / or inspection tubes. Seal tubes and chimneys with fabric per the details
- k. Precisely cut an "X" in the panel and fabric for conduit and other penetrations. Where penetrations cannot be completely sealed with the cut "X" fabric, add additional fabric wrap around the penetrating item and seal all seams to the pipe or penetrating item.
- l. Edges
- m. Cover all terminal edges with a filter fabric lap by tucking the fabric behind the core.
- n. Seal all overlapped fabric with a 2" wide strip of Red Sure Tape or 3m Red Color duct tape.
- o. Insure that all panel edges, seams, penetrations and drainage items are covered by fabric to insure no soil can enter the panel core directly.
- p. Coordinate installation of covering material within the time limits outlined in the general item above.

3.6 CATCH-BASIN INSTALLATION

- A. Set drain frames and covers with tops flush with pavement and/or planting surface.
- B. Install landscape drains in accordance with manufacturer's requirements.

3.7 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to Section 32 1313 "Landscape Architectural Cement Concrete Pavement" and 32 1223 "Cast-In-Place Concrete for Landscape Features" for requirements under this section.

3.8 DRAINAGE SYSTEM INSTALLATION

- A. Assemble and install components according to manufacturer's written instructions.
- B. Install with top surfaces of components, except piping, flush with finished surface.
- C. Coordinate with filter fabric and landscape soil contractor. Insure those contractors install filter fabric and provide soil loading fill to top edge.
- D.
- E.

3.9 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement, stone surfaces, aggregate surfacing or modular unit pavements with tops flush with pavement surface.

3.10 TRENCHING AND BACKFILLING

- A. Backfill trenches to top of pipe plus six inches (6") with sand.
- B. When trench excavated to line and grade indicated in drawings encounters hardpan, rock, mud, quicksand, debris, or other unsuitable bedding material, trench shall be further excavated to a suitable limit as directed by Landscape Architect. Excavation shall then be

backfilled with approved import material that will provide adequate pipe bedding. Import material will be cement stabilized sand unless otherwise specified by Engineer.

- C. Backfill:
 - a. Backfill the remaining trench with on site excavated material. If excavated material is unsuitable for compaction, use imported suitable material approved by Landscape Architect
 - b. Do not permit sand backfill material to mix with structural backfill within the subdrain area
 - c. All trench backfill shall be compacted to ninety-five (95%) percent relative density.
 - d. Coordinate testing with Geotechnical lab services.
- D. Obstructions and Debris: Remove hardpan, rock, mud, quicksand, debris or other unsuitable bedding material. Further excavate the trench a suitable limit as directed by the Engineer. Backfill with import material approved by the Engineer that will provide adequate pipe bedding.

3.11 PIPE INSTALLATION

- A. All pipes shall be installed and tested in accordance with Civil Engineers requirements.
- B. PVC Pipe: Install as detailed in the Drawings and in accordance with the manufacturer's current printed specifications.

3.12 SUB-SURFACE, TRENCH AND BED DRAINAGE SYSTEMS

- A. Install to locations and rim elevations as shown and detailed on the Drawings.
- B. Connect to pipe stubouts in strict accordance with the manufacturer's current printed specifications.
- C. Preparation of Trench: Accurately excavate trench as shown on the Drawings.
- D. Filter Fabric: Place fabric in bottom of trench and extend up sides and beyond trench. Overlap 12 inches at connection ends of roll.
- E. Drain Rock and Pipe: Install bedding portion of drain rock and bed pipe in place. Do not damage or displace filter fabric.
- F. Review: Prior to installing remaining drain rock backfill, request review by Landscape Architect for progress of the work.
- G. Closing: Upon acceptance, add remaining drain rock and lap over the ends of the filter fabric as shown on the Drawings.

- H. Soil Backfill: Backfill with planting soil mix to a minimum depth of 6 in. above filter fabric as shown on Drawings.

3.13 WALL DRAINAGE:

- A. Set underdrain pipe to proper elevations and maintain a continuous flow line between all points. Install perforated PVC pipe with holes facing bottom of trench.
- B. Fill trench with drainage gravel to correct elevation, as shown. Install filter fabric and immediately follow with the installation of a two (2") inch sand blanket.
- C. Install planting soil mix and plant materials as specified in Section 32 9113 "Soil Preparation".

3.14 PERFORATED DRAIN PIPE IN TRENCH

- A. Preparation of Trench: Accurately excavate trench as shown on the Drawings.
- B. Filter Fabric: Place fabric in bottom of trench and extend up sides and beyond trench. Overlap 12 inches at connecting ends of roll.
- C. Drain Rock and Pipe: Install bedding portion of drain rock and bed pipe in place. Do not damage or displace filter fabric.
- D. Review: Prior to installing remaining drain rock backfill, request review by Landscape Architect for progress of the work.
- E. Closing: Upon acceptance, add remaining drain rock and lap over the ends of the filter fabric as shown on the Drawings.
- F. Soil Backfill: Backfill to a minimum depth of 6 inches above filter fabric as shown on Drawings.
- G. Protection: Be responsible for protection of trench drain installation until commencement of work scope under Section 32 91 13 "Soil Preparation".

3.15 AREA DRAINS: Install as shown on the Drawings and in strict accordance with the manufacturer's current specifications.

3.16 PROTECTION

- A. General: Keep clean and protect sub-drainage system, trench drain and area drainage installations until commencement of work under Section 32 91 13 "Soil Preparation".
 - a. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 - b. In large, accessible piping, brushes and brooms may be used for cleaning.

- c. In small pipes, place a temporary plug in end of incomplete piping at end of each day and when work stops.
 - d. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. Sediments: Regularly inspect and clean all drain sediment buckets to prevent flooding. Sweep or hose clean all trench drains as necessary.
- C. Sub-drain: Monitor sub-drainage systems and immediately identify all problems with drainage. Make adjustments as necessary to maintain proper sub-drainage.

3.17 FIELD QUALITY CONTROL

- A. Tests: Field density test for compaction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - a. Submit separate reports for each system inspection.
 - b. Defects requiring correction include the following:
 - c. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - d. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - e. Crushed, broken, cracked, or otherwise damaged piping.
 - f. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - g. Reinspect and repeat procedure until results are satisfactory.
 - h. Do not enclose, cover, or put into service before inspection and approval.
- C. Testing: After installing drainage fill to top of pipe, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.
 - a. Test completed piping systems according to authorities having jurisdiction.
 - b. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - c. Submit separate reports for each test.
 - d. Where authorities having jurisdiction do not have published procedures, perform tests as follows:
 - e. PVC and ADS Piping: Test according to AWWA standards for Testing and Maintenance and repair items as follows:
 - 1) Leaks and pipes that do not completely drain constitute defects that must be repaired.
 - a) Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
 - b) Excavate and reinstall pipes that do not drain such that positive drainage occurs within the drainage system.

3.18 CLEAN-UP

- A. Keep all areas of work clean, neat and orderly at all times.
- B. Upon completion of work, remove off the site all surplus materials, tools, equipment, rubbish and debris resulting from the work.

END OF SECTION