

ISSUED FOR BID – SPECIFICATIONS

CONY ROAD BUILDING RENOVATION

MAINE DEPARTMENT OF AGRICULTURE, CONSERVATION & FORESTRY



JANUARY 10, 2025



TABLE OF CONTENTS

Division	Section Title
DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS	
000107	SEALS PAGE
00 11 13	NOTICE TO CONTRACTORS
00 21 13	INSTRUCTIONS TO BIDDERS
00 41 13	CONTRACTOR BID FORM
00 43 13	CONTRACTOR BID BOND
00 52 13	CONTRACT AGREEMENT
00 61 13.13	CONTRACTOR PERFORMANCE BOND
00 61 13.16	CONTRACTOR PAYMENT BOND
00 62 76	APPLICATION FOR PAYMENT
00 62 76.01	CONTINUATION SHEET
00 63 63	CHANGE ORDER FORM
00 71 00	DEFINITIONS
00 72 13	GENERAL CONDITIONS
00 73 46	WAGE DETERMINATION SCHEDULE
DIVISION 01 - GENERAL REQUIREMENTS	
011000	SUMMARY
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
014000	QUALITY REQUIREMENTS
014200	REFERENCES
014339	MOCKUPS
015000	TEMPORARY FACILITIES AND CONTROLS
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
DIVISION 02 - EXISTING CONDITIONS	
024119	SELECTIVE DEMOLITION
DIVISION 03 - CONCRETE	

034500 PRECAST ARCHITECTURAL CONCRETE

DIVISION 04 - MASONRY

042613 MASONRY VENEER

DIVISION 05 - METALS

055213 PIPE AND TUBE RAILINGS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

061000 ROUGH CARPENTRY

064116 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

072100 THERMAL INSULATION

079200 JOINT SEALANTS

DIVISION 08 - OPENINGS

081113 HOLLOW METAL DOORS AND FRAMES

081416 FLUSH WOOD DOORS

083113 ACCESS DOORS AND FRAMES

085113 ALUMINUM WINDOWS

087100 DOOR HARDWARE

087113 POWER DOOR OPERATORS

088000 GLAZING

089119 FIXED LOUVERS

DIVISION 09 - FINISHES

092216 NON-STRUCTURAL METAL FRAMING

092900 GYPSUM BOARD

099114 EXTERIOR PAINTING (MPI STANDARDS)

099124 INTERIOR PAINTING (MPI STANDARDS)

DIVISION 10 - SPECIALTIES

101423.16 ROOM-IDENTIFICATION PANEL SIGNAGE

102800 TOILET, BATH, AND LAUNDRY ACCESSORIES

DIVISION 12 - FURNISHINGS

123553.16 PLASTIC-LAMINATE-CLAD LABORATORY CASEWORK

123623.13 PLASTIC-LAMINATE-CLAD COUNTERTOPS

DIVISION 21 - FIRE SUPPRESSION

210500 COMMON WORK REQUIREMENTS FOR FIRE SUPPRESSION

210523 GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION
PIPING

211310 FIRE SUPPRESSION SPRINKLER SYSTEMS

DIVISION 22 - PLUMBING

220500 COMMON WORK REQUIREMENTS FOR PLUMBING

220523	GENERAL DUTY VALVES FOR PLUMBING PIPING
220710	PLUMBING INSULATION
221100	WATER PIPING AND SPECIALTIES
221123.21	INLINE, DOMESTIC-WATER PUMPS
221300	SANITARY WASTE AND VENT PIPING AND SPECIALTIES
223300	ELECTRIC, DOMESTIC-WATER HEATERS
224500	EMERGENCY PLUMBING FIXTURES

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

230500	BASIC MECHANICAL REQUIREMENTS
230548	VIBRATION AND SEISMIC CONTROLS FOR HVAC
230593	TESTING, ADJUSTING AND BALANCING
230600	HEATING, VENTILATING AND AIR CONDITIONING
230900	BUILDING CONTROLS SYSTEM (BCS)

DIVISION 26 - ELECTRICAL

261000	ELECTRICAL

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

283000	FIRE ALARM SYSTEM FOR LOW RISE BUILDINGS

END OF TABLE OF CONTENTS

DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Elizabeth Huckins
2. 4338
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.



B. Fire-Protection Engineer:

1. Blair B. Chamberlain, PE
2. 9292
3. Responsible for Division 21.



C. Mechanical Engineer, Plumbing:

1. Blair B. Chamberlain, PE
2. 9292
3. Responsible for Division 22.

D. Mechanical Engineer, HVAC:

1. Andre M. Hebert, PE
2. 14347
3. Responsible for Division 23.



E. Electrical Engineer:

1. Melissa A. Sierra, PE
2. 18357
3. Responsible for Divisions 26 and 28 (Fire Alarm).



END OF DOCUMENT 000107

00 11 13
Notice to Contractors

Cony Road Building Renovation

3582

The project area within the Cony Road Building is approximately 4,000 sf on the west side of the building and consists of an office and lab suite with support spaces and a storage room. The warehouse portion of the building is to remain as is except reconfiguration around restrooms. The interior renovation includes spatial reconfiguration, accessibility and finish upgrades, and building system replacement. Limited exterior scope includes window and door replacement and handrail replacement. Hazardous materials abatement is also included for identified contaminated materials within the project area.

The contract shall designate the Substantial Completion Date on or before 3 *October 2025*, and the Contract Final Completion Date on or before 31 *October 2025*.

1. Submit bids on a completed Contractor Bid Form (section 00 41 13), provided in the Bid Documents, include bid security when required, and scan each item as an attachment to an email addressed to: BGS.Architect@Maine.gov, so as to be received no later than **2:00 p.m. on 6 February 2025**. The email subject line shall be marked "**Bid for Cony Road Building Renovation**".

Bid submissions will be opened and read aloud at the time and date noted above at the Bureau of General Services office, accessible as a video conference call. Those who wish to participate in the call must submit a request for access to BGS.Architect@Maine.gov.

Any bid received after the noted time will not be considered a valid bid and will remain unopened. Any bid submitted by any other means will not be considered a valid bid. In certain circumstances, the Bureau of General Services may require the Bidder to surrender a valid paper copy of the bid form or the bid security document. The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.

2. Questions and comments on the *bid opening process* shall be addressed to: Division of Planning, Design & Construction, Bureau of General Services, 77 State House Station, Augusta, Maine 04333-0077, BGS.Architect@Maine.gov.
3. Questions and comments regarding the *project design specifications* or drawings shall be directed in writing to the Consultant during the bid period prior to the question and comment deadline of 5:00 p.m. on 30 *January 2025*.

WSP USA Buildings, Inc.
Alissa Camire, RA
alissa.camire@wsp.com

4. ☒ Bid security is required on this project.
The Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with the completed bid form submitted to the Owner. The Bid Bond form is available on the BGS website.
or
☐ Bid security is not required on this project.

00 11 13
Notice to Contractors

5. ☒ Performance and Payment Bonds are required on this project.
If noted above as required, or if any combination of Base Bid and Alternate Bids amounts selected in the award of the contract exceeds \$125,000.00, the selected Contractor shall furnish a 100% contract Performance Bond (section 00 61 13.13) and a 100% contract Payment Bond (section 00 61 13.16) in the contract amount to cover the execution of the Work. Bond forms are available on the BGS website.
or
☐ Performance and Payment Bonds are not required on this project.
6. Filed Sub-bids *are not required* on this project.
7. ☐ Pre-qualified General Contractors are utilized on this project.
insert the company name, city and state for each
or
☒ Pre-qualified General Contractors are not utilized on this project.
8. ☒ An on-site pre-bid conference (☐ *mandatory* or ☒ *optional*) will be conducted for this project.
The pre-bid conference is intended for General Contractors. Subcontractors and suppliers are welcome to attend. Contractors who arrive late or leave early for a mandatory meeting may be prohibited from participating in this meeting and bidding.
2:00 pm on January 29, 2025
333 Cony Road, Augusta, ME 04333
insert other details as needed

or
☐ An on-site pre-bid conference will not be conducted for this project.
9. Bid Documents - full sets only - will be available on or about *Friday, January 17, 2025* and may be obtained *electronically or as printed sets purchased at cost* from:
Xpress Copy Plan Room
17 Westfield Street
Portland, ME 04101
(207) 775-2444, <https://www.expressplanroom.com>
10. Bid Documents may be examined at:

AGC Maine
188 Whitten Road, Augusta, ME 04330
207-622-4741

Construction Summary
734 Chestnut Street, Manchester, NH 03104
603-627-8856

00 21 13
Instructions to Bidders

1. Bidder Requirements

- 1.1 A bidder is a Contractor which is evidently qualified, or has been specifically pre-qualified by the Bureau of General Services, to bid on the proposed project described in the Bid Documents.
- 1.2 Contractors and Subcontractors bidding on projects that utilize Filed Sub-bids shall follow the requirements outlined in these Bid Documents for such projects. See Section 00 22 13 for additional information.
- 1.3 Contractors and Subcontractors are not eligible to bid on the project when their access to project design documents prior to the bid period distribution of documents creates an unfair bidding advantage. Prohibited access includes consultation with the Owner or with design professionals engaged by the Owner regarding cost estimating, constructability review, or project scheduling. This prohibition to bid applies to open, competitive bidding or pre-qualified contractor bidding or Filed Sub-bidding. The Bureau may require additional information to determine if the activities of a Contractor constitute an unfair bidding advantage.
- 1.4 Each bidder is responsible for becoming thoroughly familiar with the Bid Documents prior to submitting a bid. The failure of a bidder to review evident site conditions, to attend available pre-bid conferences, or to receive, examine, or act on addenda to the Bid Documents shall not relieve that bidder from any obligation with respect to their bid or the execution of the work as a Contractor.
- 1.5 Prior to the award of the contract, General Contractor bidders or Filed Sub-bidders may be required to provide documented evidence to the Owner or the Bureau showing compliance with the provisions of this section, their business experience, financial capability, or performance on previous projects.
- 1.6 The selected General Contractor bidder will be required to provide proof of insurance before a contract can be executed.
- 1.7 Contracts developed from this bid shall not be assigned, sublet or transferred without the written consent of the Owner.
- 1.8 By submitting a bid the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Director of the Bureau of General Services may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.
- 1.9 The Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

00 21 13
Instructions to Bidders

- 1.10 The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.
2. Authority of Owner
- 2.1 The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.
- 2.2 Subject to the Owner's stated right to accept or reject any or all bids, the Contractor shall be selected on the basis of the lowest dollar value of an acceptable Base Bid, or any combination of Base Bid plus Alternate Bids, as well as other limited cost modifications the Owner determines may best serve the interests of the Owner. An acceptable bid is a duly submitted bid from a responsive and responsible bidder.
- 2.3 The Owner reserves the right to require Bid Bonds or Performance and Payment Bonds for any project of any contract value.
3. Submitting Bids and Bid Requirements
- 3.1 Each bid shall be submitted on the forms provided in the Bid Documents.
- 3.2 Each bid shall be valid for a period of thirty calendar days following the Project bid closing date and time. The bid expiration date may be extended in unusual circumstances by mutual consent of the Bidder and the Owner. The bid amount shall not be modified due to the bid expiration date extension.
- 3.3 Any provision contained in a bid which shows cost escalation, or any modification of schedule or other requirements shall not be accepted. Such a provision causes the bid to be invalid, or, at the discretion of the Owner and BGS, that element of the bid submission may be disregarded for the purpose of awarding the contract without that provision.
- 3.4 Bidders shall include a Bid Bond or other approved bid security with the bid form submitted to the Owner when the bid form indicates such bid security is required. The bond value shall be 5% of the bid amount. The form of bond is shown in section 00 43 13.
- 3.5 Bidders recognize that inclusion of contract bonds and the cost of those bonds is dependent on the awarded contract dollar value. Therefore, a Base Bid, or any combination of Base Bid plus Alternate Bids, as well as other limited cost modifications, resulting in a contract award shall include the cost of Performance and Payment Bonds in the submitted bid amount when the construction contract value is over \$125,000.00. Similarly, the cost of Performance and Payment Bonds is excluded in the submitted bid amount when the construction contract value is \$125,000.00 or less unless bonds are specifically required by the Bid Documents. When required for the project, the selected Contractor shall provide these bonds before a contract can be executed, pursuant to 14 M.R.S.A., Section 871, Public Works Contractors' Surety Bond Law of 1971, subsection 3. The form of bonds is shown in section 00 61 13.13 and 00 61 13.16.

00 21 13
Instructions to Bidders

- 3.6 Bidders may modify bids in writing, by the same means as the original bid submission, prior to the bid closing time. Such written amendments shall not disclose the amount of the initial bid. If so disclosed, the entire bid is considered invalid.
- 3.7 Bidders implicitly acknowledge all Addenda issued when they submit the bid form. By usual practice the Consultant shall not issue Addenda less than 72 hours prior to the bid closing time, to allow ample time for bidders to incorporate the information. However, some information, such as extending the bid due date and time, may be issued with shorter notice. Addenda shall be issued to all companies who are registered holders of Bid Documents.
- 3.8 A bid may be withdrawn without penalty if a written request by the bidder is presented to the Owner prior to the bid closing time. Such written withdrawal requests are subject to verification as required by the Bureau.
- A bid may be withdrawn without penalty after the bid closing time if, in the determination of the Bureau, evidence provided by the Contractor shows an apparent unintended error such as a miscalculation, or an erroneous number on estimating documents, was the cause of an inaccurate bid. The Bureau may allow withdrawal in consideration of the bid bond or, without utilizing a bid bond, if the Bureau considers documented evidence provided by the Contractor shows factual errors had been made on the bid form.
- 3.9 In the event State of Maine Offices unexpectedly close on the published date of a public bid opening in the location of that bid opening, prior to the time of the scheduled deadline, the new deadline for the public bid opening will be the following business day at the originally scheduled hour of the day, at the original location. Official closings are posted on the State of Maine government website.
- 3.10 The Owner may require, in a Notice of Intent to Award letter to the apparent low bidder, a Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers as both a demonstration of capability of the Bidder and as a condition of award.
- 3.11 Projects which require a State of Maine wage determination will include that schedule as part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.12 Projects which require compliance with the Davis-Bacon Act are subject to the regulations contained the Code for Federal Regulations and the federal wage determination which is made a part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.13 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.

00 41 13
Contractor Bid Form

Cony Road Building Renovation

3582

Bid Form submitted by: *email only to email address below*

Bid Administrator:

insert name of person receiving bids

BGS.Architect@Maine.gov

Bureau of General Services

111 Sewall Street, Cross State Office Building, 4th floor

77 State House Station

Augusta, Maine 04333-0077

Bidder:

Signature: _____

Printed name and
title: _____

Company name: _____

Mailing address: _____

City, state, zip code: _____

Phone number: _____

Email address: _____

State of
incorporation,
if a corporation: _____

List of all partners,
if a partnership: _____

The Bidder agrees, if the Owner offers to award the contract, to provide any and all bonds and certificates of insurance, as well as Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers if required by the Owner, and to sign the designated Construction Contract within twelve calendar days after the date of notification of such acceptance, except if the twelfth day falls on a State of Maine government holiday or other closure day, or a Saturday, or a Sunday, in which case the aforementioned documents must be received before 12:00 noon on the first available business day following the holiday, other closure day, Saturday, or Sunday.

As a guarantee thereof, the Bidder submits, together with this bid, a bid bond or other acceptable instrument as and if required by the Bid Documents.

00 41 13
Contractor Bid Form

1. The Bidder, having carefully examined the Cony Road Building Renovation Project Manual dated 10 January, 2024, prepared by WSP USA Buildings, Inc., as well as Specifications, Drawings, and any Addenda, the form of contract, and the premises and conditions relating to the work, proposes to furnish all labor, equipment and materials necessary for and reasonably incidental to the construction and completion of this project for the **Base Bid** amount of:

\$ _____ .00

2. Allowances *are not included* on this project.

No Allowances

insert brief name of Allowance

\$ 0.00

3. Alternate Bids *are included* on this project.

Alternate Bids are as shown below

Any dollar amount line below that is left blank by the Bidder shall be read as a bid of \$0.00.

1 Bid Alternate No. 1: Thermal Upgrades \$ _____ .00

2 Bid Alternate No. 2: Insulation Material \$ _____ .00

3 Bid Alternate No. 3: Generator Upgrade \$ _____ .00

4 Bid Alternate No. 4: Storage Caging \$ _____ .00

4. Bid security *is required* on this project.

If noted above as required, or if the Base Bid amount exceeds \$125,000.00, the Bidder shall include with this bid form a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with this completed bid form submitted to the Owner.

5. Filed Sub-bids *are not required* on this project.

If noted above as required, the Bidder shall include with this bid form a list of each Filed Sub-bidder selected by the Bidder on the form provided (section 00 41 13F).

00 43 13
Contractor Bid Bond

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of five percent of the bid amount, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns, signed this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the first specified bid due date, or subsequent bid due date revised by addendum.

The condition of the above obligation is such that whereas the principal has submitted to the Owner, or State of Maine, to a certain bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, for the construction of insert name of project as designated in the contract documents

Now therefore:

If said bid shall be rejected, or, in the alternate,

If said bid shall be accepted and the principal shall execute and deliver a contract in the form of contract attached hereto, properly completed in accordance with said bid, and shall furnish a bond for the faithful performance of said contract, and for the payment of all persons performing labor or furnishing material in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time within which the Obligee may accept such bid and said Surety does hereby waive notice of any such extension.

00 43 13
Contractor Bid Bond

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this **insert date, i.e.: 8th** day of **select month, select year**, which is the same date as that of the first specified bid due date, or subsequent bid due date revised by addendum.

Contractor

(Signature)

insert name and title

insert company name

insert address
insert city state zip code

Surety

(Signature)

insert name and title

insert company name

insert address
insert city state zip code

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

State of Maine CONSTRUCTION CONTRACT

Large Construction Project

*This form is used when the Contract value is \$50,000 or greater.
The Project Manual, Specifications and Drawings, and any Addenda are considered part of this Contract.*

Agreement entered into by and between the **contracting entity name** hereinafter called the **Owner** and **Contractor company name** hereinafter called the **Contractor**.

BGS Project No.: **number assigned by BGS**

Other Project No.: _____

For the following Project: **title of project as shown on bid documents** at **facility or campus name, municipality**, Maine.

The Specifications and the Drawings have been prepared by **Consultant firm name**, acting as Professional-of-Record and named in the documents as the Consultant Architect or Engineer.

The Owner and Contractor agree as follows:

ARTICLE 1 COMPENSATION AND PAYMENTS

1.1 The Owner shall pay the Contractor to furnish all labor, equipment, materials and incidentals necessary for the construction of the Work described in the Specifications and shown on the Drawings the Contract Amount as shown below.

Base Bid	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
Total Contract Amount	<u>\$0.00</u>

1.2 The Contractor's requisition shall contain sufficient detail and supporting information for the Owner to evaluate and support the payment requested.

1.2.1 Payments are due and payable twenty-five working days from the date of receipt of a Contractor requisition which is approved by the Owner.

1.2.2 Provisions for late payments are governed by 5 M.R.S. Chapter 144, *Payment of Invoices Received from Business Concerns*, and interest shall be calculated at 1% per month.

ARTICLE 2 COMMENCEMENT AND COMPLETION DATES

2.1 The Work of this Contract shall commence no sooner than the date this document is executed by the approval authority, or a subsequent date designated in the contract documents.

2.2 The Substantial Completion Date shall be _____.

2.3 The Work of this Contract shall be completed on or before the Contract Final Completion Date of _____.

2.4 The Contract Expiration Date shall be _____. (This date is the Owner's deadline for internal management of contract accounts. The Contract Expiration Date does not directly relate to any contract obligation of the Contractor.)

ARTICLE 3 INELIGIBLE BIDDER

3.1 By signing this contract the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Bureau of General Services may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.

3.2 By signing this contract the Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

3.3 The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.

ARTICLE 4 CONTRACTOR'S RESPONSIBILITIES

4.1 On this project, the Contractor ***shall*** furnish the Owner the appropriate contract bonds in the amount of 100% of the Contract Sum. Contract bonds are mandated if the Contract Sum exceeds \$125,000, or if bonds are specifically required by the Contract Documents.

4.2 The Contractor shall comply with all laws, codes and regulations applicable to the Work.

4.3 The Contractor shall acquire all permits and third-party approvals applicable to the Work not specifically identified as provided by the Owner. Costs for Contractor-provided permits and third-party approvals shall be included in the Contract Sum identified in Section 1.1 above.

4.4 The Contractor shall remain an independent agent for the duration of this Contract, shall not become an employee of the State of Maine, and shall assure that no State employee will be compensated by, or otherwise benefit from, this Contract.

4.5 The Contractor shall be responsible for any design cost, construction cost, or other cost incurred on the Project to the extent caused by the negligent acts, errors or omissions of the Contractor or their Subcontractors in the performance of Work under this Contract.

ARTICLE 5 OWNER'S RESPONSIBILITIES

5.1 The Owner shall provide full information about the objectives, schedule, constraints and existing conditions of the project. The Owner has established a budget with reasonable contingencies that meets the project requirements.

5.2 By signing this contract, the Owner attests that all State of Maine procurement requirements for this contract have been met, including the solicitation of competitive bids.

ARTICLE 6 INSTRUMENTS OF SERVICE

6.1 The Contractor's use of the drawings, specifications and other documents known as the Consultant's Instruments of Service is limited to the execution of the Contractor's scope of work of this project unless the Contractor receives the written consent of the Owner and Consultant for use elsewhere.

ARTICLE 7 MISCELLANEOUS PROVISIONS

7.1 This Contract shall be governed by the laws of the State of Maine.

7.2 The Owner and Contractor, respectively, bind themselves, their partners, successors, assigns and legal representatives to this Contract. Neither party to this Contract shall assign the Contract as a whole without written consent of the other party, which consent the Owner may withhold without cause.

7.3 Notwithstanding any other provision of this Agreement, if the Owner does not receive sufficient funds to fund this Agreement or funds are de-appropriated, or if the Owner does not receive legal authority from the Maine State Legislature or Maine Courts to expend funds intended for this Agreement, then the Owner is not obligated to make payment under this Agreement; provided, however, the Owner shall be obligated to pay for services satisfactorily performed prior to any such non-appropriation in accordance with the termination provisions of this Agreement. The Owner shall timely notify the Contractor of any non-appropriation and the effective date of the non-appropriation.

ARTICLE 8 CONTRACT DOCUMENTS

8.1 The Project Manual, Specifications and Drawings, and any Addenda, together with this agreement, form the contract. Each element is as fully a part of the Contract as if hereto attached or herein repeated.

8.2 Specifications: **indicate date of issuance of project manual**

8.3 Drawings: **note here or attach each sheet number and title**

8.4 Addenda: **note each addenda number and date, or "none"**

BGS Project No.: _____

The Contract is effective as of the date executed by the approval authority.

OWNER

CONTRACTOR

Signature Date
name and title

name of contracting entity
address

telephone
email address

Signature Date
name and title

name of contractor company
address

telephone
email address
Vendor Number

Indicate the names of the review and approval individuals appropriate to the approval authority.

select proper approval authority

Reviewed by:

Approved by:

Signature Date
insert name

Project Manager/ Contract Administrator

Signature Date
Robert Gurney, P.E.

Chief Engineer, Bureau of General Services

00 61 13.13
Contractor Performance Bond

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly and faithfully perform the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

00 61 13.13
Contractor Performance Bond

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this **insert date, i.e.: 8th** day of **select month, select year**, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

Contractor

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

Surety

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

00 61 13.16
Contractor Payment Bond

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the use and benefit of claimants, defined as an entity having a contract with the principal or with a subcontractor of the principal for labor, materials, or both labor and materials, used or reasonably required for use in the performance of the contract, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly satisfy all claims and demands incurred for all labor and materials, used or required by the principal in connection with the work described in the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, and shall fully reimburse the obligee for all outlay and expense with said obligee may incur in making good any default of said principal, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

00 61 13.16
Contractor Payment Bond

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this **insert date, i.e.: 8th** day of **select month, select year**, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

Contractor

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

Surety

(Signature)

insert name and title

insert company name

insert address

insert city state zip code

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

State of Maine
CONSTRUCTION CONTRACT
Application for Payment

Cony Road Building Renovation
333 Cony Road, Augusta, ME

Application Number: **1**

Contractor Company name
address
city state zip code

Period Start Date: **1-Apr-2025**
Period End Date: **31-Oct-2025**
BGS Project No.: **3582**
Other Project No.: **x**

1	Original Contract Amount		\$0
2	Net of Change Orders to Date (from table below)		\$0
3	Contract Sum to Date (line 1 plus or minus line 2)		\$0
4	Total Completed and Stored to Date (column G on Continuation Sheet)		\$0
5a	5% Retainage of Completed Work (columns D + E x 5%)	\$0	
5b	5% Retainage of Stored Materials (column F x 5%)	\$0	
5c	Total Retainage (column I)		\$0
6	Total Earned Less Retainage (line 4 minus line 5c)		\$0
7	Less Previous Approved Applications for Payment (line 6 from previous Application)		\$0
8	Current Payment Due (line 6 minus line 7)		\$0
9	Balance to Finish, Including Retainage (line 3 minus line 6)	\$0	

Change Order Summary	Additions	Deductions
Total Changes Approved in Previous Months	\$0	\$0
Total Changes Approved this Month	\$0	\$0
Subtotals	\$0	\$0
Net of Change Orders to Date		\$0

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information, and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which the previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

Contractor
Type company name here
Type person's name, title here

signature date

In accordance with the Contract Documents, based on on-site observations and the data comprising this Application, the Consultant certifies to the Owner that to the best of the Consultant's knowledge, information, and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the Amount Certified. **Amount Certified:** _____

Consultant (Architect or Engineer)
Type firm name here
Type person's name, title here

signature date

Owner
Type contracting entity name here
Type person's name, title here

signature date

Owner's Rep / other - clear this text if not used
Type entity name here
Type person's name, title here

signature date

Bureau of General Services
Type person's name, title here

signature date

Application Number: **1**
 Period Start Date: **1-Apr-2025**
 Period End Date: **31-Oct-2025**
 BGS Project No.: **3582**
 Other Project No.: **x**

Contractor Company name

[illegible]

	Total	\$0	\$0	\$0	\$0	\$0	0.0%	\$0	\$0

State of Maine
CONSTRUCTION CONTRACT
Change Order

Cony Road Building Renovation
 333 Cony Road, Augusta, ME

Change Order Number: **1**

Issue Date of this Document: **31-Dec-2022**

Contractor Company name
 address
 city state zip code

BGS Project No.: **3582**

Other Project No.: **x**

Cost Change

Show Deduct as a negative number, e.g.: "\$-850".

	Add	Deduct	Total
Net Amount of this Change Order	\$0	\$0	
Net Amount of Previous Change Orders	\$0	\$0	
Net of Change Orders to Date	\$0	\$0	\$0
Original Contract Amount			\$0
Revised Contract Amount			\$0

Time Change

Show Deduct as a negative number, e.g.: "-8".

	Add	Deduct	Total
Net Calendar Days Adjusted by this Change Order	0	0	
Net Calendar Days Adjusted by Previous Change Orders	0	0	
Net of Change Orders to Date	0	0	0
Original Contract Final Completion Date			31-Dec-2023
Revised Contract Final Completion Date*			31-Dec-2023

Consultant (Architect or Engineer)

Type firm name here
 Type person's name, title here

 signature date

Contractor

Type company name here
 Type person's name, title here

 signature date

Owner

Type contracting entity name here
 Type person's name, title here

 signature date

Type Entity, such as "Owner's Rep", or "not used"

Type entity name here
 Type person's name, title here

 signature date

Bureau of General Services

Division of Planning, Design & Construction
 Type person's name, title here

 signature date

Attach the "List of Change Order Items" sheet, plus all supporting documentation for each Change Order Item.

Substantial Completion Date: the deadline for first beneficial use by Owner, as certified by Consultant.

* **Contract Final Completion Date** : the Contractor's final completion deadline for contract work.

Contract Expiration Date: the Owner's deadline for internal management of contract accounts;

Contract Expiration Date does not directly relate to any contract obligation of the Contractor.

1-Dec-2023
31-Dec-2023
29-Feb-2024

List of Change Order Items

Cony Road Building Renovation
Contractor Company name

C. O. Number: 1

CO Item No.	CP No.	Item Name	Reason Code	Calendar Days*	Cost
1	1	Type brief name of Change Order Item here		0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
				0	\$0
Totals				0	\$0

Reason Codes

EO Error or omission of Consultant
 UC Unforeseen job site condition
 OC Owner-generated change
 RC Regulatory authority-generated change
 CC Contractor-generated change

* Calendar Days shows Contract Final
 Completion Date impact only.

Attach this sheet to the BGS "Change Order" cover sheet (with cost and time summaries, and signatures). Attach a "Details" sheet, and other supporting documentation, for each Change Order Item listed above.

Details of Change Order Item

Cony Road Building Renovation

333 Cony Road, Augusta, ME

Change Order Item Number

1

CP (Change Proposal) Number

1

Issue Date of this Document:

31-Oct-2021**Contractor Company name**

address

BGS Project No.:

3582

city state zip code

Other Project No.:

x

Change Order Item	Type name of Change Order Item here			
Description of Work	Type brief description here of work scope here.			
Reason or Necessity of Work	Type brief justification for change here.			
Cost Breakdown	Work by Subcontractor only	Work by Sub and Contractor	Work by Contractor only	
Subcontractor base cost	\$0	\$0		
Subcontractor markup	\$0	\$0		
Contractor base cost		\$0	\$0	
Contractor markup	\$0	\$0	\$0	
Subtotal	\$0	\$0	\$0	
Compensation	lump sum		Total Cost	\$0
Initiated by	Consultant		Calendar Days*	0
Reason Code	CC	Supporting Documentation		is attached

EO
Error or omission
of Consultant

UC
Unforeseen job site
condition

OC
Owner-
generated change

RC
Regulatory authority-
generated change

CC
Contractor-
generated change

* Calendar Days shows Contract Final Completion Date impact only.

Consultant

(Architect or Engineer)

Type firm name here

Type person's name, title here

signature

date

Contractor

Type company name here

Type person's name, title here

signature

date

Owner

Type contracting entity name here

Type person's name, title here

signature

date

Owner's Rep

Type entity name here

Type person's name, title here

signature

date

Bureau of

Division of Planning, Design & Construction

General Services

Type person's name, title here

signature

date

00 71 00
Definitions

1. Definitions

- 1.1 *Addendum*: A document issued by the Consultant that amends the Bid Documents. Addenda shall not be issued less than seventy-two hours prior to the specified bid opening time.
- 1.2 *Allowance*: A specified dollar amount for a particular scope of work or service included in the Work that is identified in the Bid Documents and included in each Bidder's Bid. The Contractor shall document expenditures for an Allowance during the Project. Any unused balance shall be credited to the Owner. The Contractor is responsible for notifying the Owner of anticipated expenses greater than the specified amount and the Owner is responsible for those additional expenses.
- 1.3 *Alternate Bid*: The Contractor's written offer of a specified dollar amount, submitted on the Bid Form, for the performance of a particular scope of work described in the Bid Documents. The Owner determines the low bidder based on the sum of the base Bid and any combination of Alternate Bids that the Owner selects.
- 1.4 *Architect*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to "Consultant" in State of Maine contract forms.
- 1.5 *Architectural Supplemental Instruction (ASI)*: A written instruction from the Architect for the purpose of clarification of the Contract Documents. An ASI does not alter the Contract Price or Contract Time. ASIs may be responses to RFIs and shall be issued by the Architect in a timely manner to avoid any negative impact on the Schedule of the Work.
- 1.6 *Bid*: The Contractor's written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of the Work. A Bid may include bonds or other requirements. A base Bid is separate and distinct from Alternate Bids, being the only cost component necessary for the award of the contract, and representing the minimum amount of Work that is essential for the functioning of the Project.
- 1.7 *Bid Bond*: The security designated in the Bid Documents, furnished by Bidders as a guaranty of good faith to enter into a contract with the Owner, should a contract be awarded to that Bidder.
- 1.8 *Bidder*: Any business entity, individual or corporation that submits a bid for the performance of the work described in the Bid Documents, acting directly or through a duly authorized representative. See also *Responsive and Responsible Bidder*.
- 1.9 *Bid Documents*: The drawings, procurement and contracting requirements, general requirements, and the written specifications -including all addenda, that a bidder is required to reference in the submission of a bid.
- 1.10 *Bureau*: The State of Maine Bureau of General Services, or BGS, in the Department of Administrative and Financial Services.
- 1.11 *Calendar days*: Consecutive days, as occurring on a calendar, taking into account each day of the week, month, year, and any religious, national or local holidays. Calendar days are used for changes in Contract Time.

00 71 00
Definitions

- 1.12 *Certificate of Substantial Completion*: A document developed by the Consultant that describes the final status of the Work and establishes the date that the Owner may use the facility for its intended purpose. The Certificate of Substantial Completion may also include a provisional list of items - a "punch list" - remaining to be completed by the Contractor. The Certificate of Substantial Completion identifies the date from which the project warranty period commences.
- 1.13 *Certificate of Occupancy*: A document developed by a local jurisdiction such as the Code Enforcement Officer that grants permission to the Owner to occupy a building.
- 1.14 *Change Order (CO)*: A document that modifies the contract and establishes the basis of a specific adjustment to the Contract Price or the Contract Time, or both. Change Orders may address correction of omissions, errors, and document discrepancies, or additional requirements. Change Orders should include all labor, materials and incidentals required to complete the work described. A Change Order is not valid until signed by the Contractor, Owner and Consultant and approved by the Bureau.
- 1.15 *Change Order Proposal (COP) (see also Proposal)*: Contract change proposed by the Contractor regarding the contract amount, requirements, or time. The Contractor implements the work of a COP after it is accepted by all parties. Accepted COPs are incorporated into the contract by Change Order.
- 1.16 *Clerk of the Works*: The authorized representative of the Consultant on the job site. Clerk of the Works is sometimes called the Architect's representative.
- 1.17 *Construction Change Directive (CCD)*: A written order prepared by the Consultant and signed by the Owner and Consultant, directing a change in the Work prior to final agreement with the Contractor on adjustment, if any, in the Contract Price or Contract Time, or both.
- 1.18 *Contract*: A written agreement between the Owner and the successful bidder which obligates the Contractor to perform the work specified in the Contract Documents and obligates the Owner to compensate the Contractor at the mutually accepted sum, rates or prices.
- 1.19 *Contract Bonds (also known as Payment and Performance Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.20 *Contract Documents*: The drawings and written specifications (including all addenda), Standard General Conditions, and the contract (including all Change Orders subsequently incorporated in the documents).
- 1.21 *Contract Expiration Date*: Date determined by the Owner as a deadline for internal management of contract accounts. This allows time after the Contract Final Completion Date for processing the final Requisition for Payment. The Contract Expiration Date does not directly relate to any contract obligation of the Contractor.
- 1.22 *Contract Final Completion Date*: Point of time when the Work is fully completed in compliance with the Contract Documents, as certified by the Consultant. Final payment to the Contractor is due upon Final Completion of the Project.
- 1.23 *Contract Price*: The dollar amount of the construction contract, also called *Contract Sum*.

00 71 00
Definitions

- 1.24 *Contract Time*: The designated duration of time to execute the Work of the contract, with a specific date for completion.
- 1.25 *Contractor*: Also called the "General Contractor" or "GC" the individual or entity undertaking the execution of the general contract work under the terms of the contract with the Owner, acting directly or through a duly authorized representative. The Contractor is responsible for the means, methods and materials utilized in the execution and completion of the Work.
- 1.26 *Consultant*: The Architect or Engineer acting as Professional-of-Record for the Project. The Consultant is responsible for the design of the Project.
- 1.27 *Drawings*: The graphic and pictorial portion of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.
- 1.28 *Engineer*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to "Consultant" in State of Maine contract forms.
- 1.29 *Filed Sub-bid*: The designated major Subcontractor's (or, in some cases, Contractor's) written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of a particular portion of the Work. A Filed Sub-bid may include bonds or other requirements.
- 1.30 *General Requirements*: The on-site overhead expense items the Contractor provides for the Project, typically including, but not limited to, building permits, construction supervision, Contract Bonds, insurance, field office, temporary utilities, rubbish removal, and site fencing. Overhead expenses of the Contractor's general operation are not included. Sometimes referred to as the Contractor's General Conditions.
- 1.31 *Owner*: The State agency which is represented by duly authorized individuals. The Owner is responsible for defining the scope of the Project and compensation to the Consultant and Contractor.
- 1.32 *Owner's Representative*: The individual or entity contracted by the Owner to be an advisor and information conduit regarding the Project.
- 1.33 *Overhead*: General and administrative expenses of the Contractor's principal and branch offices, including payroll costs and other compensation of Contractor employees, deductibles paid on any insurance policy, charges against the Contractor for delinquent payments, and costs related to the correction of defective work, and the Contractor's capital expenses, including interest on capital used for the work.
- 1.34 *Performance and Payment Bonds (also known as Contract Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.35 *Post-Bid Addendum*: Document issued by the Consultant that defines a potential Change Order prior to signing of the construction contract. The Post-Bid Addendum allows the Owner to negotiate

00 71 00
Definitions

contract changes with the Bidder submitting the lowest valid bid, only if the negotiated changes to the Bid Documents result in no change or no increase in the bid price.

A Post-Bid Addendum may also be issued after a competitive construction Bid opening to those Bidders who submitted a Bid initially, for the purpose of rebidding the Project work without re-advertising.

- 1.36 *Project*: The construction project proposed by the Owner to be constructed according to the Contract Documents. The Project, a public improvement, may be tied logistically to other public improvements and other activities conducted by the Owner or other contractors.
- 1.37 *Proposal (see also Change Order Proposal)*: The Contractor's written offer submitted to the Owner for consideration containing a specified dollar amount or rate, for a specific scope of work, and including a schedule impact, if any. A proposal shall include all costs for overhead and profit. The Contractor implements the work of a Proposal after it is accepted by all parties. Accepted Proposals are incorporated into the contract by Change Order.
- 1.38 *Proposal Request (PR)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.39 *Punch List*: A document that identifies the items of work remaining to be done by the Contractor at the Close Out of a Project. The Punch List is created as a result of a final inspection of the work only after the Contractor attests that all of the Work is in its complete and permanent status.
- 1.40 *Request For Information (RFI)*: A Contractor's written request to the Consultant for clarification, definition or description of the Work. RFIs shall be presented by the Contractor in a timely manner to avoid any negative impact on the Schedule of the Work.
- 1.41 *Request For Proposal (RFP)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.42 *Requisition for Payment*: The document in which the Contractor certifies that the Work described is, to the best of the Contractor's knowledge, information and belief, complete and that all previous payments have been paid by the Contractor to Subcontractors and suppliers, and that the current requested payment is now due. See *Schedule of Values*.
- 1.43 *Responsive and Responsible Bidder*: A bidder who complies, when submitting a bid on a given project, with the following *responsive* standards, as required by the Bid Documents:
 - submits specific qualifications to bid the project, if required;
 - attends mandatory pre-bid conferences, if required;
 - submits a bid prior to the close of the bid period;
 - submits a complete bid form;
 - submits a bid without indications of intent contrary to the stated requirements;
 - submits other materials and information, such as bid security, as required;
 and, meets the following minimums regarding these *responsible* standards:
 - sustains a satisfactory record of project performance;
 - maintains a permanent place of business in a known physical location;
 - possesses the financial means for short- and long-term operations;
 - possesses the appropriate technical experience and capabilities;
 - employs adequate personnel and subcontractor resources;

00 71 00
Definitions

maintains the equipment needed to perform the work;
complies with the proposed implementation schedule;
complies with the insurance and bonding requirements;
provides post-construction warranty coverage;
and other criteria which can be considered relevant to the contract.

- 1.44 *Retainage*: The amount, calculated at five percent (5%) of the contract value or a scheduled value, that the Owner shall withhold from the Contractor until the work or portion of work is declared substantially complete or otherwise accepted by the Owner. The Owner may, if requested, reduce the amount withheld if the Owner deems it desirable and prudent to do so. (See Title 5 M.R.S.A., Section 1746.)
- 1.45 *Sample*: A physical example provided by the Contractor which illustrates materials, equipment or workmanship and establishes standards by which the Work will be judged.
- 1.46 *Schedule of the Work*: The document prepared by the Contractor and approved by the Owner that specifies the dates on which the Contractor plans to begin and complete various parts of the Work, including dates on which information and approvals are required from the Owner.
- 1.47 *Schedule of Values*: The document prepared by the Contractor and approved by the Owner before the commencement of the Work that specifies the dollar values of discrete portions of the Work equal in sum to the contract amount. The Schedule of Values is used to document progress payments of the Work in regular (usually monthly) requisitions for payment. See *Requisition for Payment*.
- 1.48 *Shop Drawings*: The drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
- 1.49 *Specifications*: The portion of the Contract Documents consisting of the written requirements of the Work for materials, equipment, systems, standards, workmanship, and performance of related services.
- 1.50 *Subcontractor*: An individual or entity undertaking the execution of any part of the Work by virtue of a written agreement with the Contractor or any other Subcontractor. Also, an individual or entity retained by the Contractor or any other Subcontractor as an independent contractor to provide the labor, materials, equipment or services necessary to complete a specific portion of the Work.
- 1.51 *Substantial Completion Date*: Point of time when the Work or a designated portion of the Work is sufficiently complete in compliance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended purpose without unscheduled disruption. Substantial Completion is documented by the date of the Certificate of Substantial Completion signed by the Owner and the Contractor.
- 1.52 *Superintendent*: The representative of the Contractor on the job site, authorized by the Contractor to receive and fulfill instructions from the Consultant.
- 1.53 *Surety*: The individual or entity that is legally bound with the Contractor and Subcontractor to insure the faithful performance of the contract and for the payment of the bills for labor, materials and equipment by the Contractor and Subcontractors.

00 71 00
Definitions

- 1.54 *Work*: The construction and services, whether completed or partially completed, including all labor, materials, equipment and services provided or to be provided by the Contractor and Subcontractors to fulfill the requirements of the Project as described in the Contract Documents.

00 72 13
General Conditions

Table of Contents of this General Conditions Section

1. Preconstruction Conference	2
2. Intent and Correlation of Contract Documents.....	2
3. Additional Drawings and Specifications	3
4. Ownership of Contract Documents	3
5. Permits, Laws, and Regulations	3
6. Taxes	4
7. Labor and Wages.....	4
8. Indemnification	5
9. Insurance Requirements	5
10. Contract Bonds.....	6
11. Patents and Royalties	7
12. Surveys, Layout of Work	7
13. Record of Documents.....	7
14. Allowances	8
15. Shop Drawings.....	8
16. Samples	8
17. Substitutions	8
18. Assignment of Contract.....	9
19. Separate Contracts.....	9
20. Subcontracts	10
21. Contractor-Subcontractor Relationship	10
22. Supervision of the Work.....	11
23. Observation of the Work	11
24. Consultant's Status.....	12
25. Management of the Premises	12
26. Safety and Security of the Premises	13
27. Changes in the Work	14
28. Correction of the Work.....	15
29. Owner's Right to do Work.....	16
30. Termination of Contract and Stop Work Action	16
31. Delays and Extension of Time	17
32. Payments to the Contractor	18
33. Payments Withheld	19
34. Liens	19
35. Workmanship	19
36. Close-out of the Work	20
37. Date of Completion and Liquidated Damages	21
38. Dispute Resolution	21

00 72 13
General Conditions

1. Preconstruction Conference

- 1.1 The Contractor shall, upon acceptance of a contract and prior to commencing work, schedule a preconstruction conference with the Owner and Consultant. The purpose of this conference is as follows.
 - 1.1.1 Introduce all parties who have a significant role in the Project, including:
 - Owner (State agency or other contracting entity)
 - Owner's Representative
 - Consultant (Architect or Engineer)
 - Subconsultants
 - Clerk-of-the-works
 - Contractor (GC)
 - Superintendent
 - Subcontractors
 - Other State agencies
 - Construction testing company
 - Commissioning agent
 - Special Inspections agent
 - Bureau of General Services (BGS);
 - 1.1.2 Review the responsibilities of each party;
 - 1.1.3 Review any previously-identified special provisions of the Project;
 - 1.1.4 Review the Schedule of the Work calendar submitted by the Contractor to be approved by the Owner and Consultant;
 - 1.1.5 Review the Schedule of Values form submitted by the Contractor to be approved by the Owner and Consultant;
 - 1.1.6 Establish routines for Shop Drawing approval, contract changes, requisitions, et cetera;
 - 1.1.7 discuss jobsite issues;
 - 1.1.8 Discuss Project close-out procedures;
 - 1.1.9 Provide an opportunity for clarification of Contract Documents before work begins; and
 - 1.1.10 Schedule regular meetings at appropriate intervals for the review of the progress of the Work.

2. Intent and Correlation of Contract Documents

- 2.1 The intent of the Contract Documents is to describe the complete Project. The Contract Documents consist of various components; each component complements the others. What is shown as a requirement by any one component shall be inferred as a requirement on all corresponding components.
- 2.2 The Contractor shall furnish all labor, equipment and materials, tools, transportation, insurance, services, supplies, operations and methods necessary for, and reasonably incidental to, the construction and completion of the Project. Any work that deviates from the Contract Documents which appears to be required by the exigencies of construction or by inconsistencies in the Contract Documents, will be determined by the Consultant and authorized in writing by the Consultant, Owner and the Bureau prior to execution. The Contractor shall be responsible for requesting clarifying information where the intent of the Contract Documents is uncertain.
- 2.3 The Contractor shall not utilize any apparent error or omission in the Contract Documents to the disadvantage of the Owner. The Contractor shall promptly notify the Consultant in writing of such errors or omissions. The Consultant shall make any corrections or clarifications necessary in such a situation to document the true intent of the Contract Documents.

00 72 13
General Conditions

3. Additional Drawings and Specifications

- 3.1 Upon the written request of the Contractor, the Owner shall provide, at no expense to the Contractor, up to five sets of printed Drawings and Specifications for the execution of the Work.
- 3.2 The Consultant shall promptly furnish to the Contractor revised Drawings and Specifications, for the area of the documents where those revisions apply, when corrections or clarifications are made by the Consultant. All such information shall be consistent with, and reasonably inferred from, the Contract Documents. The Contractor shall do no work without the proper Drawings and Specifications.

4. Ownership of Contract Documents

- 4.1 The designs represented on the Contract Documents are the property of the Consultant. The Drawings and Specifications shall not be used on other work without consent of the Consultant.

5. Permits, Laws, and Regulations

- 5.1 The Owner is responsible for obtaining any zoning approvals or other similar local project approvals necessary to complete the Work, unless otherwise specified in the Contract Documents.
- 5.2 The Owner is responsible for obtaining Maine Department of Environmental Protection, Maine Department of Transportation, or other similar state government project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.3 The Owner is responsible for obtaining any federal agency project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.4 The Owner is responsible for obtaining all easements for permanent structures or permanent changes in existing facilities.
- 5.5 The Contractor is responsible for obtaining and paying for all permits and licenses necessary for the implementation of the Work. The Contractor shall notify the Owner of any delays, variance or restrictions that may result from the issuing of permits and licenses.
- 5.6 The Contractor shall comply with all ordinances, laws, rules and regulations and make all required notices bearing on the implementation of the Work. In the event the Contractor observes disagreement between the Drawings and Specifications and any ordinances, laws, rules and regulations, the Contractor shall promptly notify the Consultant in writing. Any necessary changes shall be made as provided in the contract for changes in the work. The Contractor shall not perform any work knowing it to be contrary to such ordinances, laws, rules and regulations.
- 5.7 The Contractor shall comply with local, state and federal regulations regarding construction safety and all other aspects of the Work.
- 5.8 The Contractor shall comply with the Maine Code of Fair Practices and Affirmative Action, 5 M.R.S. §784 (2).

00 72 13
General Conditions

6. Taxes

- 6.1 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.
- 6.2 Section 1760 further provides in subsection 61 that sales to a construction contractor or its subcontractor of tangible personal property that is to be physically incorporated in, and become a permanent part of, real property for sale to or owned by the Owner, are exempt from Maine State sales and use taxes. Tangible personal property is defined in 36 M.R.S. §1752 (17).
- 6.3 The Contractor may contact Maine Revenue Services, 24 State House Station, Augusta, Maine 04333 for guidance on tax exempt regulations authorized by 36 M.R.S. §1760 and detailed in Rule 302 (18-125 CMR 302).

7. Labor and Wages

- 7.1 The Contractor shall conform to the labor laws of the State of Maine, and all other laws, ordinances, and legal requirements affecting the work in Maine.
- 7.2 The Consultant shall include a wage determination document prepared by the Maine Department of Labor in the Contract Documents for state-funded contracts in excess of \$50,000. The document shows the minimum wages required to be paid to each category of labor employed on the project.
- 7.3 On projects requiring a Maine wage determination, the Contractor shall submit monthly payroll records to the Owner ("the contracting agency") showing the name and occupation of all workers and all independent contractors employed on the project. The monthly submission must also include the Contractor's company name, the title of the project, hours worked, hourly rate or other method of remuneration, and the actual wages or other compensation paid to each person.
- 7.4 The Contractor shall not reveal, in the payroll records submitted to the Owner, personal information regarding workers and independent contractors, other than the information described above. Such information shall not include Social Security number, employee identification number, or employee address or phone number, for example.
- 7.5 The Contractor shall conform to Maine statute (39-A M.R.S. §105-A (6)) by providing to the Workers' Compensation Board a list of all subcontractors and independent contractors on the job site and a record of the entity to whom that subcontractor or independent contractor is directly contracted and by whom that subcontractor or independent contractor is insured for workers' compensation purposes.
- 7.6 The Contractor shall enforce strict discipline and good order among their employees at all times, and shall not employ any person unfit or unskilled to do the work assigned to them.
- 7.7 The Contractor shall promptly pay all employees when their compensation is due, shall promptly pay all others who have billed and are due for materials, supplies and services used in the Work, and shall promptly pay all others who have billed and are due for insurance, workers compensation coverage, federal and state unemployment compensation, and Social Security

00 72 13
General Conditions

charges pertaining to this Project. Before final payments are made, the Contractor shall furnish to the Owner affidavits that all such payments described above have been made.

- 7.8 The Contractor may contact the Maine Department of Labor, 54 State House Station, Augusta, Maine 04333 for guidance on labor issues.
- 7.9 The Contractor may contact the Maine Workers' Compensation Board, 27 State House Station, Augusta, Maine 04333 for guidance on workers' compensation issues.

8. Indemnification

- 8.1 The Contractor shall indemnify and hold harmless the Owner and its officers and employees from and against any and all damages, liabilities, and costs, including reasonable attorney's fees, and defense costs, for any and all injuries to persons or property, including claims for violation of intellectual property rights, to the extent caused by the negligent acts or omissions of the Contractor, its employees, agents, officers or subcontractors in the performance of work under this Agreement. The Contractor shall not be liable for claims to the extent caused by the negligent acts or omissions of the Owner or for actions taken in reasonable reliance on written instructions of the Owner.
- 8.2 The Contractor shall notify the Owner promptly of all claims arising out of the performance of work under this Agreement by the Contractor, its employees or agents, officers or subcontractors.
- 8.3 This indemnity provision shall survive the termination of the Agreement, completion of the project or the expiration of the term of the Agreement.

9. Insurance Requirements

- 9.1 The Contractor shall provide, with each original of the signed Contract, an insurance certificate or certificates acceptable to the Owner and BGS. The Contractor shall submit insurance certificates to the Owner and BGS at the commencement of this Contract and at policy renewal or revision dates. The certificates shall identify the project name and BGS project number, and shall name the Owner as certificate holder and as additional insured for general liability and automobile liability coverages. The submitted forms shall contain a provision that coverage afforded under the insurance policies will not be canceled or materially changed unless at least ten days prior written notice by registered letter has been given to the Owner and BGS.
- 9.2 The Owner does not warrant or represent that the insurance required herein constitutes an insurance portfolio which adequately addresses all risks faced by the Contractor or its Subcontractors. The Contractor is responsible for the existence, extent and adequacy of insurance prior to commencement of work. The Contractor shall not allow any Subcontractor to commence work until all similar insurance required of the Subcontractor has been confirmed by the Contractor.
- 9.3 The Contractor shall procure and maintain primary insurance for the duration of the Project and, if written on a Claims-Made basis, shall also procure and maintain Extended Reporting Period (ERP) insurance for the period of time that any claims could be brought. The Contractor shall ensure that all Subcontractors they engage or employ will procure and maintain similar insurance

00 72 13
General Conditions

in form and amount acceptable to the Owner and BGS. At a minimum, the insurance shall be of the types and limits set forth herein protecting the Contractor from claims which may result from the Contractor's execution of the Work, whether such execution be by the Contractor or by those employed by the Contractor or by those for whose acts they may be liable. All required insurance coverages shall be placed with carriers authorized to conduct business in the State of Maine by the Maine Bureau of Insurance.

- 9.3.1 The Contractor shall have Workers' Compensation insurance for all employees on the Project site in accordance with the requirements of the Workers' Compensation law of the State of Maine. Minimum acceptable limits for Employer's Liability are:

Bodily Injury by Accident.....	\$500,000
Bodily Injury by Disease.....	\$500,000 Each Employee
Bodily Injury by Disease.....	\$500,000 Policy Limit

- 9.3.2 The Contractor shall have Commercial General Liability insurance providing coverage for bodily injury and property damage liability for all hazards of the Project including premise and operations, products and completed operations, contractual, and personal injury liabilities. The policy shall include collapse and underground coverage as well as explosion coverage if explosion hazards exist. Aggregate limits shall apply on a location or project basis. Minimum acceptable limits are:

General aggregate limit.....	\$2,000,000
Products and completed operations aggregate	\$1,000,000
Each occurrence limit.....	\$1,000,000
Personal injury aggregate.....	\$1,000,000

- 9.3.3 The Contractor shall have Automobile Liability insurance against claims for bodily injury, death or property damage resulting from the maintenance, ownership or use of all owned, non-owned and hired automobiles, trucks and trailers. Minimum acceptable limit is:

Any one accident or loss	\$500,000

- 9.3.4 For the portion of a project which is new construction, the Contractor shall procure and maintain Builder's Risk insurance naming the Owner, Contractor, and any Subcontractor as insureds as their interest may appear. Covered causes of loss form shall be all Risks of Direct Physical Loss, endorsed to include flood, earthquake, transit and sprinkler leakage where sprinkler coverage is applicable. Unless specifically authorized in writing by the Owner, the limit of insurance shall not be less than the initial contract amount, for the portion of the project which is new construction, and coverage shall apply during the entire contract period and until the work is accepted by the Owner.

- 9.3.5 The Contractor shall have Owner's Protective Liability insurance for contract values \$50,000 and above, naming the Owner as the Named Insured. Minimum acceptable limits are:

General aggregate limit.....	\$2,000,000
Each occurrence limit.....	\$1,000,000

10. Contract Bonds

- 10.1 When noted as required in the Bid Documents, the Contractor shall provide to the Owner a Performance Bond and a Payment Bond, or "contract bonds", upon execution of the contract. Each bond value shall be for the full amount of the contract and issued by a surety company authorized to do business in the State of Maine as approved by the Owner. The bonds shall be

00 72 13
General Conditions

executed on the forms furnished in the Bid Documents. The bonds shall allow for any subsequent additions or deductions of the contract.

- 10.2 The contract bonds shall continue in effect for one year after final acceptance of the contract to protect the Owner's interest in connection with the one year guarantee of workmanship and materials and to assure settlement of claims for the payment of all bills for labor, materials and equipment by the Contractor.

11. Patents and Royalties

- 11.1 The Contractor shall, for all time, secure for the Owner the free and undisputed right to the use of any patented articles or methods used in the Work. The expense of defending any suits for infringement or alleged infringement of such patents shall be borne by the Contractor. Awards made regarding patent suits shall be paid by the Contractor. The Contractor shall hold the Owner harmless regarding patent suits that may arise due to installations made by the Contractor, and to any awards made as a result of such suits.
- 11.2 Any royalty payments related to the work done by the Contractor for the Project shall be borne by the Contractor. The Contractor shall hold the Owner harmless regarding any royalty payments that may arise due to installations made by the Contractor.

12. Surveys, Layout of Work

- 12.1 The Owner shall furnish all property surveys unless otherwise specified.
- 12.2 The Contractor is responsible for correctly staking out the Work on the site. The Contractor shall employ a competent surveyor to position all construction on the site. The surveyor shall run the axis lines, establish correct datum points and check each line and point on the site to insure their accuracy. All such lines and points shall be carefully preserved throughout the construction.
- 12.3 The Contractor shall lay out all work from dimensions given on the Drawings. The Contractor shall take measurements and verify dimensions of any existing work that affects the Work or to which the Work is to be fitted. The Contractor is solely responsible for the accuracy of all measurements. The Contractor shall verify all grades, lines, levels, elevations and dimensions shown on the Drawings and report any errors or inconsistencies to the Consultant prior to commencing work.

13. Record of Documents

- 13.1 The Contractor shall maintain one complete set of Contract Documents on the jobsite, in good order and current status, for access by the Owner and Consultant.
- 13.2 The Contractor shall maintain, continuously updated, complete records of Requests for Information, Architectural Supplemental Instructions (or equivalent), Information Bulletins, supplemental sketches, Change Order Proposals, Change Orders, Shop Drawings, testing reports, et cetera, for access by the Owner and Consultant.

00 72 13
General Conditions

14. Allowances

- 14.1 The Contract Price shall include all allowances described in the Contract Documents. The Contractor shall include all overhead and profit necessary to implement each allowance in their Contract Price.
- 14.2 The Contractor shall not be required to employ parties for allowance work against whom the Contractor has a reasonable objection. In such a case, the Contractor shall notify the Owner in writing of their position and shall propose an alternative party to complete the work of the allowance.

15. Shop Drawings

- 15.1 The Contractor shall administer Shop Drawings prepared by the Contractor, Subcontractors, suppliers or others to conform to the approved Schedule of the Work. The Contractor shall verify all field measurements, check and authorize all Shop Drawings and schedules required by the Work. The Contractor is the responsible party and contact for the Contractor's work as well as that of Subcontractors, suppliers or others who provide Shop Drawings.
- 15.2 The Consultant shall review and acknowledge Shop Drawings, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents.
- 15.3 The Contractor shall provide monthly updated logs containing: requests for information, information bulletins, supplemental instructions, supplemental sketches, change order proposals, change orders, submittals, testing and deficiencies.
- 15.4 The Contractor shall make any corrections required by the Consultant, and shall submit a quantity of corrected copies as may be needed. The acceptance of Shop Drawings or schedules by the Consultant shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications, unless the Contractor has called such deviations to the attention of the Consultant at the time of submission and secured the Consultant's written approval. The acceptance of Shop Drawings or schedules by the Consultant does not relieve the Contractor from responsibility for errors in Shop Drawings or schedules.

16. Samples

- 16.1 The Contractor shall furnish for approval, with reasonable promptness, all samples as directed by the Consultant. The Consultant shall review and approve such samples, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents. The subsequent work shall be in accord with the approved samples.

17. Substitutions

- 17.1 The Contractor shall furnish items and materials described in the Contract Documents. If the item or material specified describes a proprietary product, or uses the name of a manufacturer, the term "or approved equal" shall be implied, if it is not included in the text. The specific item or material specified establishes a minimum standard for the general design, level of quality, type, function, durability, efficiency, reliability, compatibility, warranty coverage, installation factors

00 72 13
General Conditions

and required maintenance. The Drawing or written Specification shall not be construed to exclude other manufacturers products of comparable design, quality, and efficiency.

- 17.2 The Contractor may submit detailed information about a proposed substitution to the Consultant for consideration. Particular models of items and particular materials which the Contractor asserts to be equal to the items and materials identified in the Contract Documents shall be allowed only with written approval by the Consultant. The request for substitution shall include a cost comparison and a reason or reasons for the substitution.
- 17.3 The Consultant may request additional information about the proposed substitution. The approval or rejection of a proposed substitution may be based on timeliness of the request, source of the information, the considerations of minimum standards described above, or other considerations. The Consultant should briefly state the rationale for the decision. The decision shall be considered final.
- 17.4 The duration of a substitution review process can not be the basis for a claim for delay in the Schedule of the Work.

18. Assignment of Contract

- 18.1 The Contractor shall not assign or sublet the contract as a whole without the written consent of the Owner. The Contractor shall not assign any money due to the Contractor without the written consent of the Owner.

19. Separate Contracts

- 19.1 The Owner reserves the right to create other contracts in connection with this Project using similar General Conditions. The Contractor shall allow the Owner's other contractors reasonable opportunity for the delivery and storage of materials and the execution of their work. The Contractor shall coordinate and properly connect the Work of all contractors.
- 19.2 The Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in work of the Owner's other contractors that impacts the proper execution or results of the Contractor. The Contractor's failure to observe or report any deficiencies constitutes an acceptance of the Owner's other contractors work as suitable for the interface of the Contractor's work, except for latent deficiencies in the Owner's other contractors work.
- 19.3 Similarly, the Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in their own work that would impact the proper execution or results of the Owner's other contractors.
- 19.4 The Contractor shall report to the Consultant and Owner any conflicts or claims for damages with the Owner's other contractors and settle such conflicts or claims for damages by mutual agreement or arbitration, if necessary, at no expense to the Owner.
- 19.5 In the event the Owner's other contractors sue the Owner regarding any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend such proceedings at the Contractor's expense. The Contractor shall pay or satisfy any judgment that may arise against the Owner, and pay all other costs incurred.

00 72 13
General Conditions

20. Subcontracts

- 20.1 The Contractor shall not subcontract any part of this contract without the written permission of the Owner.
- 20.2 The Contractor shall submit a complete list of named Subcontractors and material suppliers to the Consultant and Owner for approval by the Owner prior to commencing work. The Subcontractors named shall be reputable companies of recognized standing with a record of satisfactory work.
- 20.3 The Contractor shall not employ any Subcontractor or use any material until they have been approved, or where there is reason to believe the resulting work will not comply with the Contract Documents.
- 20.4 The Contractor, not the Owner, is as fully responsible for the acts and omissions of Subcontractors and of persons employed by them, as the Contractor is for the acts and omissions of persons directly or indirectly employed by the Contractor.
- 20.5 Neither the Contract Documents nor any Contractor-Subcontractor contract shall indicate, infer or create any direct contractual relationship between any Subcontractor and the Owner.

21. Contractor-Subcontractor Relationship

- 21.1 The Contractor shall be bound to the Subcontractor by all the obligations in the Contract Documents that bind the Contractor to the Owner.
- 21.2 The Contractor shall pay the Subcontractor, in proportion to the dollar value of the work completed and requisitioned by the Subcontractor, the approved dollar amount allowed to the Contractor no more than seven days after receipt of payment from the Owner.
- 21.3 The Contractor shall pay the Subcontractor accordingly if the Contract Documents or the subcontract provide for earlier or larger payments than described in the provision above.
- 21.4 The Contractor shall pay the Subcontractor for completed and requisitioned subcontract work, less retainage, no more than seven days after receipt of payment from the Owner for the Contractor's approved Requisition for Payment, even if the Consultant fails to certify a portion of the Requisition for Payment for a cause not the fault of the Subcontractor.
- 21.5 The Contractor shall not make a claim for liquidated damages or penalty for delay in any amount in excess of amounts that are specified by the subcontract.
- 21.6 The Contractor shall not make a claim for services rendered or materials furnished by the Subcontractor unless written notice is given by the Contractor to the Subcontractor within ten calendar days of the day in which the claim originated.
- 21.7 The Contractor shall give the Subcontractor an opportunity to present and to submit evidence in any progress conference or disputes involving subcontract work.

00 72 13
General Conditions

- 21.8 The Contractor shall pay the Subcontractor a just share of any fire insurance payment received by the Contractor.
- 21.9 The Subcontractor shall be bound to the Contractor by the terms of the Contract Documents and assumes toward the Contractor all the obligations and responsibilities that the Contractor, by those documents, assumes toward the Owner.
- 21.10 The Subcontractor shall submit applications for payment to the Contractor in such reasonable time as to enable the Contractor to apply for payment as specified.
- 21.11 The Subcontractor shall make any claims for extra cost, extensions of time or damages, to the Contractor in the manner provided in these General Conditions for like claims by the Contractor to the Owner, except that the time for the Subcontractor to make claims for extra cost is seven calendar days after the receipt of Consultant's instructions.

22. Supervision of the Work

- 22.1 During all stages of the Work the Contractor shall have a competent superintendent, with any necessary assistant superintendents, overseeing the project. The superintendent shall not be reassigned without the consent of the Owner unless a superintendent ceases to be employed by the Contractor due to unsatisfactory performance.
- 22.2 The superintendent represents the Contractor on the jobsite. Directives given by the Consultant or Owner to the superintendent shall be as binding as if given directly to the Contractor's main office. All important directives shall be confirmed in writing to the Contractor. The Consultant and Owner are not responsible for the acts or omissions of the superintendent or assistant superintendents.
- 22.3 The Contractor shall provide supervision of the Work equal to the industry's highest standard of care. The superintendent shall carefully study and compare all Contract Documents and promptly report any error, inconsistency or omission discovered to the Consultant. The Contractor may not necessarily be held liable for damages resulting directly from any error, inconsistency or omission in the Contract Documents or other instructions by the Consultant that was not revealed by the superintendent in a timely way.

23. Observation of the Work

- 23.1 The Contractor shall allow the Owner, the Consultant and the Bureau continuous access to the site for the purpose of observation of the progress of the work. All necessary safeguards and accommodations for such observations shall be provided by the Contractor.
- 23.2 The Contractor shall coordinate all required testing, approval or demonstration of the Work. The Contractor shall give sufficient notice to the appropriate parties of readiness for testing, inspection or examination.
- 23.3 The Contractor shall schedule inspections and obtain all required certificates of inspection for inspections by a party other than the Consultant.

00 72 13
General Conditions

- 23.4 The Consultant shall make all scheduled observations promptly, prior to the work being concealed or buried by the Contractor. If approval of the Work is required of the Consultant, the Contractor shall notify the Consultant of the construction schedule in this regard. Work concealed or buried prior to the Consultant's approval may need to be uncovered at the Contractor's expense.
- 23.5 The Consultant may order reexamination of questioned work, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to conform to the Contract Documents, the Owner shall pay the expense of the reexamination and remedial work. If the work is found to not conform to the Contract Documents, the Contractor shall pay the expense, unless the defect in the work was caused by the Owner's Contractor, whose responsibility the reexamination expense becomes.
- 23.6 The Bureau shall periodically observe the Work during the course of construction and make recommendations to the Contractor or Consultant as necessary. Such recommendations shall be considered and implemented through the usual means for changes to the Work.
24. Consultant's Status
- 24.1 The Consultant represents the Owner during the construction period, and observes the work in progress on behalf of the Owner. The Consultant has authority to act on behalf of the Owner only to the extent expressly provided by the Contract Documents or otherwise demonstrated to the Contractor. The Consultant has authority to stop the work whenever such an action is necessary, in the Consultant's reasonable opinion, to ensure the proper execution of the contract.
- 24.2 The Consultant is the interpreter of the conditions of the contract and the judge of its performance. The Consultant shall favor neither the Owner nor the Contractor, but shall use the Consultant's powers under the contract to enforce faithful performance by both parties.
- 24.3 In the event of the termination of the Consultant's employment on the project prior to completion of the work, the Owner shall appoint a capable and reputable replacement. The status of the new Consultant relative to this contract shall be that of the former Consultant.
25. Management of the Premises
- 25.1 The Contractor shall place equipment and materials, and conduct activities on the premises in a manner that does not unreasonably hinder site circulation, environmental stability, or any long term effect. Likewise, the Consultant's directions shall not cause the use of premises to be impeded for the Contractor or Owner.
- 25.2 The Contractor shall not use the premises for any purpose other than that which is directly related to the scope of work. The Owner shall not use the premises for any purpose incompatible with the proposed work simultaneous to the work of the Contractor.
- 25.3 The Contractor shall enforce the Consultant's instructions regarding information posted on the premises such as signage and advertisements, as well as activities conducted on the premises such as fires, and smoking.

00 72 13
General Conditions

25.4 The Owner may occupy any part of the Project that is completed with the written consent of the Contractor, and without prejudice to any of the rights of the Owner or Contractor. Such use or occupancy shall not, in and of itself, be construed as a final acceptance of any work or materials.

26. Safety and Security of the Premises

26.1 The Contractor shall designate, and make known to the Consultant and the Owner, a safety officer whose duty is the prevention of accidents on the site.

26.2 The Contractor shall continuously maintain security on the premises and protect from unreasonable occasion of injury all people authorized to be on the job site. The Contractor shall also effectively protect the property and adjacent properties from damage or loss.

26.3 The Contractor shall take all necessary precautions to ensure the safety of workers and others on and adjacent to the site, abiding by applicable local, state and federal safety regulations. The Contractor shall erect and continuously maintain safeguards for the protection of workers and others, and shall post signs and other warnings regarding hazards associated with the construction process, such as protruding fasteners, moving equipment, trenches and holes, scaffolding, window, door or stair openings, and falling materials.

26.4 The Contractor shall restore the premises to conditions that existed prior to the start of the project at areas not intended to be altered according to the Contract Documents.

26.5 The Contractor shall protect existing utilities and exercise care working in the vicinity of utilities shown in the Drawings and Specifications or otherwise located by the Contractor.

26.6 The Contractor shall protect from damage existing trees and other significant plantings and landscape features of the site which will remain a permanent part of the site. If necessary or indicated in the Contract Documents, tree trunks shall be boxed and barriers erected to prevent damage to tree branches or roots.

26.7 The Contractor shall repair or replace damage to the Work caused by the Contractor's or Subcontractor's forces, including that which is reasonably protected, at the expense of the responsible party.

26.8 The Contractor shall not load, or allow to be loaded, any part of the Project with a force which imperils personal or structural safety. The Consultant may consult with the Contractor on such means and methods of construction, however, the ultimate responsibility lies with the Contractor.

26.9 The Contractor shall not jeopardize any work in place with subsequent construction activities such as blasting, drilling, excavating, cutting, patching or altering work. The Consultant must approve altering any structural components of the project. The Contractor shall supervise all construction activities carried out by others on site to ensure that the work is neatly done and in a manner that will not endanger the structure or the component parts.

26.10 The Contractor may act with their sole discretion in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Contractor may negotiate with the Owner for compensation for expenses due to such emergency work.

00 72 13
General Conditions

- 26.11 The Contractor and Subcontractors shall have no responsibility for the identification, discovery, presence, handling, removal or disposal of, or exposure of persons to, hazardous materials in any form at the project site. The Contractor shall avoid disruption of any hazardous materials or toxic substances at the project site and promptly notify the Owner in writing on the occasion of such a discovery.
- 26.12 The Contractor shall keep the premises free of any unsafe accumulation of waste materials caused by the work. The Contractor shall regularly keep the spaces "broom clean". See the Close-out of the Work provisions of this section regarding cleaning at the completion of the project.

27. Changes in the Work

- 27.1 The Contractor shall not proceed with extra work without an approved Change Order or Construction Change Directive. A Change Order which has been properly signed by all parties shall become a part of the contract.
- 27.2 A Change Order is the usual document for directing changes in the Work. In certain circumstances, however, the Owner may utilize a Construction Change Directive to direct the Contractor to perform changes in the Work that are generally consistent with the scope of the project. The Owner shall use a Construction Change Directive only when the normal process for approving changes to the Work has failed to the detriment of the Project, or when agreement on the terms of a Change Order cannot be met, or when an urgent situation requires, in the Owner's judgment, prompt action by the Contractor.
- 27.3 The Consultant shall prepare the Construction Change Directive representing a complete scope of work, with proposed Contract Price and Contract Time revisions, if any, clearly stated.
- 27.4 The Contractor shall promptly carry out a Construction Change Directive which has been signed by the Owner and the Consultant. Work thus completed by the Contractor constitutes the basis for a Change Order. Changes in the Contract Price and Contract Time shall be as defined in the Construction Change Directive unless subsequently negotiated with some other terms.
- 27.5 The method of determining the dollar value of extra work shall be by:
- .1 an estimate of the Contractor accepted by Owner as a lump sum, or
 - .2 unit prices named in the contract or subsequently agreed upon, or
 - .3 cost plus a designated percentage, or
 - .4 cost plus a fixed fee.
- 27.6 The Contractor shall determine the dollar value of the extra work for both the lump sum and cost plus designated percentage methods so as not to exceed the following rates. The rates include all overhead and profit expenses.
- .1 Contractor - for any work performed by the Contractor's own forces, up to 20% of the cost;
 - .2 Subcontractor - for work performed by Subcontractor's own forces, up to 20% of the cost;
 - .3 Contractor - for work performed by Contractor's Subcontractor, up to 10% of the amount due the Subcontractor.
- 27.7 The Contractor shall keep and provide records as needed or directed for the cost plus designated percentage method. The Consultant shall review and certify the appropriate amount which

00 72 13
General Conditions

includes the Contractor's overhead and profit. The Owner shall make payments based on the Consultant's certificate.

- 27.8 Cost reflected in Change Orders shall be limited to the following: cost of materials, cost of delivery, cost of labor (including Social Security, pension, Workers' Compensation insurance, and unemployment insurance), and cost of rental of power tools and equipment. Labor cost may include a pro-ratio share of a foreman's time only in the case of an extension of contract time granted due to the Change Order.
- 27.9 Overhead reflected in Change Orders shall be limited to the following: bond premium, supervision, wages of clerks, time keepers, and watchmen, small tools, incidental expenses, general office expenses, and all other overhead expenses directly related to the Change Order.
- 27.10 The Contractor shall provide credit to the Owner for labor, materials, equipment and other costs but not overhead and profit expenses for those Change Order items that result in a net value of credit to the contract.
- 27.11 The Owner may change the scope of work of the Project without invalidating the contract. The Owner shall notify the Contractor of a change of the scope of work for the Owner's Contractors, which may affect the work of this Contractor, without invalidating the contract. Change Orders for extension of the time caused by such changes shall be developed at the time of directing the change in scope of work.
- 27.12 The Consultant may order minor changes in the Work, not involving extra cost, which is consistent with the intent of the design or project.
- 27.13 The Contractor shall immediately give written notification to the Consultant of latent conditions discovered at the site which materially differ from those represented in the Drawings or Specifications, and which may eventually result in a change in the scope of work. The Contractor shall suspend work until receiving direction from the Consultant. The Consultant shall promptly investigate the conditions and respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the discovered conditions warrant a Change Order.
- 27.14 The Contractor shall, within ten calendar days of receipt of the information, give written notification to the Consultant if the Contractor claims that instructions by the Consultant will constitute extra cost not accounted for by Change Order or otherwise under the contract. The Consultant shall promptly respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the Contractor's claim warrants a Change Order.
28. Correction of the Work
- 28.1 The Contractor shall promptly remove from the premises all work the Consultant declares is non-conforming to the contract. The Contractor shall replace the work properly at no expense to the Owner. The Contractor is also responsible for the expenses of others whose work was damaged or destroyed by such remedial work.

00 72 13
General Conditions

- 28.2 The Owner may elect to remove non-conforming work if it is not removed by the Contractor within a reasonable time, that time defined in a written notice from the Consultant. The Owner may elect to store removed non-conforming work not removed by the Contractor at the Contractor's expense. The Owner may, with ten days written notice, dispose of materials which the Contractor does not remove. The Owner may sell the materials and apply the net proceeds, after deducting all expenses, to the costs that should have been borne by the Contractor.
- 28.3 The Contractor shall remedy any defects due to faulty materials or workmanship and pay for any related damage to other work which appears within a period of one year from the date of substantial completion, and in accord with the terms of any guarantees provided in the contract. The Owner shall promptly give notice of observed defects to the Contractor and Consultant. The Consultant shall determine the status of all claimed defects. The Contractor shall perform all remedial work without unjustifiable delay in either the initial response or the corrective action.
- 28.4 The Consultant may authorize, after a reasonable notification to the Contractor, an equitable deduction from the contract amount in lieu of the Contractor correcting non-conforming or defective work.
29. Owner's Right to do Work
- 29.1 The Owner may, using other contractors, correct deficiencies attributable to the Contractor, or complete unfinished work. Such action shall take place only after giving the Contractor three days written notice, and provided the Consultant approves of the proposed course of action as an appropriate remedy. The Owner may then deduct the cost of the remedial work from the amount due the Contractor.
- 29.2 The Owner may act with their sole discretion when the Contractor is unable to take action in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Owner shall inform the Contractor of the emergency work performed, particularly where it may affect the work of the Contractor.
30. Termination of Contract and Stop Work Action
- 30.1 The Owner may, owing to a certificate of the Consultant indicating that sufficient cause exists to justify such action, without prejudice to any other right or remedy and after giving the Contractor and the Contractor's surety seven days written notice, terminate the employment of the Contractor. At that time the Owner may take possession of the premises and of all materials,

00 72 13
General Conditions

tools and appliances on the premises and finish the work by whatever method the Owner may deem expedient. Cause for such action by the Owner includes:

- .1 the contractor is adjudged bankrupt, or makes a general assignment for the benefit of its creditors, or
- .2 a receiver is appointed due to the Contractor's insolvency, or
- .3 the Contractor persistently or repeatedly refuses or fails to provide enough properly skilled workers or proper materials, or
- .4 the Contractor fails to make prompt payment to Subcontractors or suppliers of materials or labor, or
- .5 the Contractor persistently disregards laws, ordinances or the instructions of the Consultant, or is otherwise found guilty of a substantial violation of a provision of the Contract Documents.

30.2 The Contractor is not entitled, as a consequence of the termination of the employment of the Contractor as described above, to receive any further payment until the Work is finished. If the unpaid balance of the contract amount exceeds the expense of finishing the Work, including compensation for additional architectural, managerial and administrative services, such balance shall be paid to the Contractor. If the expense of finishing the Work exceeds the unpaid balance, the Contractor shall pay the difference to the Owner. The Consultant shall certify the expense incurred by the Contractor's default. This obligation for payment shall continue to exist after termination of the contract.

30.3 The Contractor may, if the Work is stopped by order of any court or other public authority for a period of thirty consecutive days, and through no act or fault of the Contractor or of anyone employed by the Contractor, with seven days written notice to the Owner and the Consultant, terminate this contract. The Contractor may then recover from the Owner payment for all work executed, any proven loss and reasonable profit and damage.

30.4 The Contractor may, if the Consultant fails to issue a certificate for payment within seven days after the Contractor's formal request for payment, through no fault of the Contractor, or if the Owner fails to pay to the Contractor within 30 days after submission of any sum certified by the Consultant, with seven days written notice to the Owner and the Consultant, stop the Work or terminate this Contract.

31. Delays and Extension of Time

31.1 The completion date of the contract shall be extended if the work is delayed by changes ordered in the work which have approved time extensions, or by an act or neglect of the Owner, the Consultant, or the Owner's Contractor, or by strikes, lockouts, fire, flooding, unusual delay in transportation, unavoidable casualties, or by other causes beyond the Contractor's control. The Consultant shall determine the status of all claimed causes.

31.2 The contract shall not be extended for delay occurring more than seven calendar days before the Contractor's claim made in writing to the Consultant. In case of a continuing cause of delay, only one claim is necessary.

31.3 The contract shall not be extended due to failure of the Consultant to furnish drawings if no schedule or agreement is made between the Contractor and the Consultant indicating the dates

00 72 13
General Conditions

which drawings shall be furnished and fourteen calendar days has passed after said date for such drawings.

- 31.4 This article does not exclude the recovery of damages for delay by either party under other provisions in the Contract Document.

32. Payments to the Contractor

- 32.1 As noted under *Preconstruction Conference* in this section, the Contractor shall submit a Schedule of Values form, before the first application for payment, for approval by the Owner and Consultant. The Consultant may direct the Contractor to provide evidence that supports the correctness of the form. The approved Schedule of Values shall be used as a basis for payments.
- 32.2 The Contractor shall submit an application for each payment ("Requisition for Payment") on a form approved by the Owner and Consultant. The Consultant may require receipts or other documents showing the Contractor's payments for materials and labor, including payments to Subcontractors.
- 32.3 The Contractor shall submit Requisitions for Payment as the work progresses not more frequently than once each month, unless the Owner approves a more frequent interval due to unusual circumstances. The Requisition for Payment is based on the proportionate quantities of the various classes of work completed or incorporated in the Work, in agreement with the actual progress of the Work and the dollar value indicated in the Schedule of Values.
- 32.4 The Consultant shall verify and certify each Requisition for Payment which appears to be complete and correct prior to payment being made by the Owner. The Consultant may certify an appropriate amount for materials not incorporated in the Work which have been delivered and suitably stored at the site. The Contractor shall submit bills of sale, insurance certificates, or other such documents that will adequately protect the Owner's interests prior to payments being certified.
- 32.5 In the event any materials delivered but not yet incorporated in the Work have been included in a certified Requisition for Payment with payment made, and said materials thereafter are damaged, deteriorated or destroyed, or for any reason whatsoever become unsuitable or unavailable for use in the Work, the full amount previously allowed shall be deducted from subsequent payments unless the Contractor satisfactorily replaces said material.
- 32.6 The Contractor may request certification of an appropriate dollar amount for materials not incorporated in the Work which have been delivered and suitably stored away from the site. The Contractor shall submit bills of sale, insurance certificates, right-of-entry documents or other such documents that will adequately protect the Owner's interests. The Consultant shall determine if the Contractor's documentation for the materials is complete and specifically designated for the Project. The Owner may allow certification of such payments.
- 32.7 Subcontractors may request, and shall receive from the Consultant, copies of approved Requisitions for Payment showing the amounts certified in the Schedule of Values.
- 32.8 Certified Requisitions for Payment, payments made to the Contractor, or partial or entire occupancy of the project by the Owner shall not constitute an acceptance of any work that does

00 72 13
General Conditions

not conform to the Contract Documents. The making and acceptance of the final payment constitutes a waiver of all claims by the Owner, other than those arising from unsettled liens, from faulty work or materials appearing within one year from final payment or from requirements of the Drawings and Specifications, and of all claims by the Contractor, except those previously made and still unsettled.

33. Payments Withheld

- 33.1 The Owner shall retain five percent of each payment due the Contractor as part security for the fulfillment of the contract by the Contractor. The Owner may make payment of a portion of this “retainage” to the Contractor temporarily or permanently during the progress of the Work. The Owner may thereafter withhold further payments until the full amount of the five percent is reestablished. The Contractor may deposit with the Maine State Treasurer certain securities in place of retainage amounts due according to Maine Statute (5 M.R.S. §1746).
- 33.2 The Consultant may withhold or nullify the whole or a portion of any Requisitions for Payment submitted by the Contractor in the amount that may be necessary, in his reasonable opinion, to protect the Owner from loss due to any of the following:
- .1 defective work not remedied;
 - .2 claims filed or reasonable evidence indicating probable filing of claims;
 - .3 failure to make payments properly to Subcontractors or suppliers;
 - .4 a reasonable doubt that the contract can be completed for the balance then unpaid;
 - .5 liability for damage to another contractor.

The Owner shall make payment to the Contractor, in the amount withheld, when the above circumstances are removed.

34. Liens

- 34.1 The Contractor shall deliver to the Owner a complete release of all liens arising out of this contract before the final payment or any part of the retainage payment is released. The Contractor shall provide with the release of liens an affidavit asserting each release includes all labor and materials for which a lien could be filed. Alternately, the Contractor, in the event any Subcontractor or supplier refuses to furnish a release of lien in full, may furnish a bond satisfactory to the Owner, to indemnify the Owner against any lien.
- 34.2 In the event any lien remains unsatisfied after all payments to the Contractor are made by the Owner, the Contractor shall refund to the Owner all money that the latter may be compelled to pay in discharging such lien, including all cost and reasonable attorney’s fees.

35. Workmanship

- 35.1 The Contractor shall provide materials, equipment, and installed work equal to or better than the quality specified in the Contract Documents and approved in submittal and sample. The installation methods shall be of the highest standards, and the best obtainable from the respective trades. The Consultant’s decision on the quality of work shall be final.

00 72 13
General Conditions

- 35.2 The Contractor shall know local labor conditions for skilled and unskilled labor in order to apply the labor appropriately to the Work. All labor shall be performed by individuals well skilled in their respective trades.
- 35.3 The Contractor shall perform all cutting, fitting, patching and placing of work in such a manner to allow subsequent work to fit properly, whether that be by the Contractor, the Owner's Contractors or others. The Owner and Consultant may advise the Contractor regarding such subsequent work. Notwithstanding the notification or knowledge of such subsequent work, the Contractor may be directed to comply with this standard of compatible construction by the Consultant at the Contractor's expense.
- 35.4 The Contractor shall request clarification or revision of any design work by the Consultant, prior to commencing that work, in a circumstance where the Contractor believes the work cannot feasibly be completed at the highest quality, or as indicated in the Contract Documents. The Consultant shall respond to such requests in a timely way, providing clarifying information, a feasible revision, or instruction allowing a reduced quality of work. The Contractor shall follow the direction of the Consultant regarding the required request for information.
- 35.5 The Contractor shall guarantee the Work against any defects in workmanship and materials for a period of one year commencing with the date of the Certificate of Substantial Completion, unless specified otherwise for specific elements of the project. The Work may also be subdivided in mutually agreed upon components, each defined by a separate Certificate of Substantial Completion.
36. Close-out of the Work
- 36.1 The Contractor shall remove from the premises all waste materials caused by the work. The Contractor shall make the spaces "broom clean" unless a more thorough cleaning is specified. The Contractor shall clean all windows and glass immediately prior to the final inspection, unless otherwise directed.
- 36.2 The Owner may conduct the cleaning of the premises where the Contractor, duly notified by the Consultant, fails to adequately complete the task. The expense of this cleaning may be deducted from the sum due to the Contractor.
- 36.3 The Contractor shall participate in all final inspections and acknowledge the documentation of unsatisfactory work, customarily called the "punch list", to be corrected by the Contractor. The Consultant shall document the successful completion of the Work in a dated Certificate of Substantial Completion, to be signed by Owner, Consultant, and Contractor.
- 36.4 The Contractor shall not call for final inspection of any portion of the Work that is not completely and permanently installed. The Contractor may be found liable for the expenses of individuals called to final inspection meetings prematurely.
- 36.5 The Contractor and all major Subcontractors shall participate in the end-of-warranty-period conference, typically scheduled close to one year after the Substantial Completion date.

00 72 13
General Conditions

37. Date of Completion and Liquidated Damages

- 37.1 The Contractor may make a written request to the Owner for an extension or reduction of time, if necessary. The request shall include the reasons the Contractor believes justifies the proposed completion date. The Owner may grant the revision of the contract completion date if the Work was delayed due to conditions beyond the control and the responsibility of the Contractor. The Contractor shall not conduct unauthorized accelerated work or file delay claims to recover alleged damages for unauthorized early completion.
- 37.2 The Contractor shall vigorously pursue the completion of the Work and notify the Owner of any factors that have, may, or will affect the approved Schedule of the Work. The Contractor may be found responsible for expenses of the Owner or Consultant if the Contractor fails to make notification of project delays.
- 37.3 The Project is planned to be done in an orderly fashion which allows for an iterative submittal review process, construction administration including minor changes in the Work and some bad weather. The Contractor shall not file delay claims to recover alleged damages on work the Consultant determines has followed the expected rate of progress.
- 37.4 The Consultant shall prepare the Certificate of Substantial Completion which, when signed by the Owner and the Contractor, documents the date of Substantial Completion of the Work or a designated portion of the Work. The Owner shall not consider the issuance of a Certificate of Occupancy by an outside authority a prerequisite for Substantial Completion if the Certificate of Occupancy cannot be obtained due to factors beyond the Contractor's control.
- 37.5 Liquidated Damages may be deducted from the sum due to the Contractor for each calendar day that the Work remains uncompleted after the completion date specified in the Contract or an approved amended completion date. The dollar amount per day shall be calculated using the Schedule of Liquidated Damages table shown below.

If the original contract amount is:	The per day Liquidated Damages shall be:
Less than \$100,000	\$250
\$100,000 to less than \$2,000,000	\$750
\$2,000,000 to less than \$10,000,000	\$1,500
\$10,000,000 and greater	\$1,500 plus \$250 for each \$2,000,000 over \$10,000,000

38. Dispute Resolution

38.1 Mediation

- 38.1.1 A dispute between the parties which arises under this Contract which cannot be resolved through informal negotiation, shall be submitted to a neutral mediator jointly selected by the parties.
- 38.1.2 Either party may file suit before or during mediation if the party, in good faith, deems it to be necessary to avoid losing the right to sue due to a statute of limitations. If suit is filed before good faith mediation efforts are completed, the party filing suit shall agree to stay all proceedings in the lawsuit pending completion of the mediation process, provided such stay is without prejudice.

00 72 13
General Conditions

38.1.3 In any mediation between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

38.2 Arbitration

38.2.1 If the dispute is not resolved through mediation, the dispute shall be settled by arbitration. The arbitration shall be conducted before a panel of three arbitrators. Each party shall select one arbitrator; the third arbitrator shall be appointed by the arbitrators selected by the parties. The arbitration shall be conducted in accordance with the Maine Uniform Arbitration Act (MUAA), except as otherwise provided in this section.

38.2.2 The decision of the arbitrators shall be final and binding upon all parties. The decision may be entered in court as provided in the MUAA.

38.2.3 The costs of the arbitration, including the arbitrators' fees shall be borne equally by the parties to the arbitration, unless the arbitrator orders otherwise.

38.2.4 In any arbitration between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

00 73 46
Wage Determination Schedule

PART 1- GENERAL

1.1 Related Documents

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specifications Sections, apply to this Section.

1.2 Summary

- A. This Section includes the wage determination requirements for Contractors as issued by the State of Maine Department of Labor Bureau of Labor Standards or the United States Department of Labor.

1.3 Requirements

- A. Conform to the wage determination schedule for this project which is shown on the following page.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

State of Maine Department of Labor - Bureau of Labor Standards
Augusta, Maine 04333-0045 - Telephone (207) 623-7906

Wage Determination - In accordance with 26 MRS §1301 et. seq., this is a determination by the Bureau of Labor Standards, of the fair minimum wage rate to be paid to laborers and workers employed on the below titled project.

2024 Fair Minimum Wage Rates -- Building 2 Kennebec County (other than 1 or 2 family homes)

Occupational Title	Minimum Wage	Minimum Benefit	Total
Brickmasons And Blockmasons	\$42.55	\$28.02	\$70.57
Bulldozer Operator	\$31.50	\$7.53	\$39.03
Carpenter	\$29.68	\$12.51	\$42.19
Cement Masons And Concrete Finisher	\$24.13	\$4.15	\$28.28
Commercial Divers	\$30.00	\$4.62	\$34.62
Construction And Maintenance Painters	\$24.00	\$0.00	\$24.00
Construction Laborer	\$22.67	\$2.80	\$25.47
Crane And Tower Operators	\$38.50	\$10.43	\$48.93
Crushing Grinding And Polishing Machine Operators	\$23.00	\$4.94	\$27.94
Drywall And Ceiling Tile Installers	\$26.20	\$10.62	\$36.82
Earth Drillers - Except Oil And Gas	\$21.61	\$5.53	\$27.14
Electrical Power - Line Installer And Repairers	\$38.93	\$8.91	\$47.84
Electricians	\$38.51	\$6.00	\$44.51
Elevator Installers And Repairers	\$68.38	\$45.29	\$113.67
Excavating And Loading Machine And Dragline Operators	\$54.28	\$34.31	\$88.59
Excavator Operator	\$28.00	\$1.67	\$29.67
Fence Erectors	\$26.75	\$4.05	\$30.80
Flaggers	\$20.00	\$0.38	\$20.38
Floor Layers - Except Carpet/Wood/Hard Tiles	\$27.25	\$6.59	\$33.84
Glaziers	\$37.00	\$6.60	\$43.60
Grader/Scraper Operator	\$23.00	\$1.99	\$24.99
Hazardous Materials Removal Workers	\$21.00	\$1.99	\$22.99
Heating And Air Conditioning And Refrigeration Mechanics And Installers	\$32.00	\$5.60	\$37.60
Heavy And Tractor - Trailer Truck Drivers	\$22.75	\$1.04	\$23.79
Highway Maintenance Workers	\$20.00	\$0.00	\$20.00
Industrial Machinery Mechanics	\$31.25	\$1.01	\$32.26
Industrial Truck And Tractor Operators	\$29.25	\$4.06	\$33.31
Insulation Worker - Mechanical	\$23.00	\$3.59	\$26.59
Ironworker - Ornamental	\$30.83	\$24.97	\$55.80
Light Truck Or Delivery Services Drivers	\$23.34	\$1.67	\$25.01
Millwrights	\$33.75	\$8.78	\$42.53
Mobile Heavy Equipment Mechanics - Except Engines	\$27.75	\$4.89	\$32.64
Operating Engineers And Other Equipment Operators	\$24.00	\$2.38	\$26.38
Paver Operator	\$27.03	\$6.49	\$33.52
Pile-Driver Operators	\$32.75	\$1.95	\$34.70
Pipelayers	\$28.50	\$4.89	\$33.39
Plumbers Pipe Fitters And Steamfitters	\$29.50	\$5.48	\$34.98
Pump Operators - Except Wellhead Pumpers	\$31.49	\$32.08	\$63.57
Radio Cellular And Tower Equipment Installers	\$26.00	\$3.77	\$29.77
Reclaimer Operator	\$27.03	\$7.68	\$34.71
Reinforcing Iron And Rebar Workers	\$30.83	\$24.97	\$55.80
Riggers	\$29.25	\$7.79	\$37.04
Roofers	\$23.75	\$3.11	\$26.86
Screed/Wheelman	\$29.25	\$4.94	\$34.19
Sheet Metal Workers	\$25.00	\$5.35	\$30.35
Structural Iron And Steel Workers	\$30.08	\$7.61	\$37.69
Tapers	\$32.63	\$0.00	\$32.63
Telecommunications Equipment Installers And Repairers - Except Line Installers	\$28.00	\$6.35	\$34.35
Telecommunications Line Installers And Repairers	\$31.03	\$18.73	\$49.76
Tile And Marble Setters	\$27.75	\$6.73	\$34.48

Welders are classified as the trade to which welding is incidental (e.g. welding structural steel is Structural Iron and Steel Worker)

Apprentices – The minimum wage rates for registered apprentices are the rates recognized in the sponsorship agreement for registered apprentices working in the pertinent classification.

For any other specific trade on this project not listed above, contact the Bureau of Labor Standards for further clarification.

Title 26 §1310 requires that a clearly legible statement of all fair minimum wage and benefits rates to be paid the several classes of laborers, workers and mechanics employed on the construction on the public work must be kept posted in a prominent and easily accessible place at the site by each contractor and subcontractor subject to sections 1304 to 1313.

Appeal – Any person affected by the determination of these rates may appeal to the Commissioner of Labor by filing a written notice with the Commissioner stating the specific grounds of the objection within ten (10) days from the filing of these rates.

A true copy

Attest: Scott R. Cotnoir
Scott R. Cotnoir
Wage & Hour Director
Bureau of Labor Standards

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Multiple Work Packages.
6. Work under Owner's separate contracts.
7. Future work not part of this Project.
8. Owner's product purchase contracts.
9. Owner-furnished/Contractor-installed (OFCI) products.
10. Owner-furnished/Owner-installed (OFOI) products.
11. Contractor-furnished/Owner-installed (CFOI) products.
12. Contractor's use of site and premises.
13. Coordination with occupants.
14. Work restrictions.
15. Specification and Drawing conventions.
16. 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.

1.3 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.

1.4 PROJECT INFORMATION

- A. Project Identification: Cony Road Building Renovation.

1. Project Location: 333 Cony Road, Augusta, ME 04330.

- B. Owner: State of Maine, Department of Agriculture, Conservation and Forestry, 18 Elkins Lane, Augusta, ME 04330.
 - 1. Owner's Representative: Celeste J. Poulin, MPS, Director of Quality Assurance and Regulations, 207-287-4456.
- C. Architect: WSP USA Buildings, Inc.
 - 1. Architect's Representative: Elizabeth Huckins, NCARB, NCIDQ, 2 Monument Square, Suite 200, Portland, ME 04101, 207-775-5401.
- D. Other Owner Consultants: Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. Hazardous Materials Assessment: Haley Ward has prepared the following portions of the Contract Documents:
 - a. Hazardous Materials Assessment Representative: Michael D. Sauda, MPH, CSP, One Merchants Plaza, Suite 701, Bangor, ME 04401, 207-989-4824.
 - b. Scope of Services: Limited Hazardous Materials Assessment (May 2, 2024) and Supplemental Hazardous Materials Assessment (June 20, 2024)
- E. 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.

1.5 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 project area within the Cony Road Building is approximately 4,000 sf on the west side of the building and consists of an office and lab suite with support spaces and a storage room. The warehouse portion of the building is to remain as is except reconfiguration around restrooms. The interior renovation includes spatial reconfiguration, accessibility and finish upgrades, and building system replacement. Limited exterior scope includes window and door replacement and handrail replacement.
 - 2. Hazardous materials have been identified within the work area, including asbestos containing materials (ACM), lead-based paint/coatings (LBP), and polychlorinated biphenyls (PCB). Refer to the Limited Hazardous Materials Assessment (May 2, 2024) and Supplemental Hazardous Materials Assessment (June 20, 2024) included at the end of this section.
 - a. The Contractor shall be responsible for preparation of a site-specific asbestos abatement project design and work plan for each work area. An Asbestos Abatement Design Consultant licensed by the Maine Department of Environmental Protection (MDEP) will prepare the design.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.6 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.

1.7 WORK UNDER OWNER'S SEPARATE CONTRACTS

- A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.
- B. Concurrent Work: Owner has awarded or will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.
 1. Contract to install photovoltaic panels on the roof.

1.8 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limits on Use of Site: Limit use of Project site to Work in areas within the Contract limits. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 1. 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.

1.9 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.

1.10 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 between 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
- 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 Architect and Owner not less than 3 work days in advance of proposed 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 Architect and Owner not less than three work days in advance of proposed disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances within the existing building, on Project site, and on Owner's property is not permitted.
- F. 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.

1.11 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 Contracting Requirements: General provisions of the Contract, including General 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.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000



HALEY WARD

ENGINEERING | ENVIRONMENTAL | SURVEYING

LIMITED HAZARDOUS MATERIALS ASSESSMENT

FOR

**333 CONY ROAD
AUGUSTA, MAINE**

Prepared For: DEPARTMENT OF AGRICULTURE,
CONSERVATION, AND FORESTRY
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MAY 2, 2024
JN: 10720.005

**Report Prepared By:
Haley Ward, Inc.**

One Merchants Plaza, Suite 701 | Bangor, Maine 04401



EXECUTIVE SUMMARY

Haley Ward, Inc. (Haley Ward) completed a Limited Hazardous Materials Assessment (HMA) on April 17, 2024, to identify and assess hazardous materials to support planned renovations of a portion of the Department of Agriculture, Conservation, and Forestry (DACF) building located at 333 Cony Road in Augusta, Maine.

This assessment was completed to identify and assess suspect Asbestos-Containing Materials (ACM), Lead-Based Paint (LBP)/lead-containing surface coatings, Polychlorinated Biphenyls (PCBs), and Potential Hazardous Materials/Wastes and Universal Wastes which would require either special handling and disposal or would be regulated prior to, or during, planned renovations.

The single-story structure located at 333 Cony Road, built circa 1960, consists of a masonry building with brick veneer siding and a flat roof system. The HMA was completed in areas identified by DACF for planned renovation, including:

- Boiler Room
- Restrooms
- Janitor's Closet
- Laboratory and associated closet
- File Storage (Conference) Room
- Laboratory Office
- Two office areas
- Hallway adjacent to above rooms
- Carpenter Shop and Storage area

Room designations are based on a marked up 1961 floor plan provided by DACF.

The following is a summary of findings of the assessment:

Asbestos-Containing Materials (ACM)

Laboratory analytical results for sampled building materials identified the following materials as asbestos-containing:

- Nine-inch by nine-inch (9x9) off-white floor tile with brown flecks and associated black adhesive
- Mudded pipe fitting insulation
- Exterior window glazing

LBP/Lead-Containing Surface Coatings

LBP/lead-containing surface coatings were identified on the interior and exterior of the assessed portions of the building, including:



Interior

- Lower ceramic tile walls in restrooms
- Glazed ceramic block wall in hallway (to right of exit door) – glazed ceramic block wall
- Glazed ceramic block wall in laboratory and associated closet
- Glazed ceramic block wall in laboratory office

Exterior

- Door header to Boiler Room
- Door header to Hallway
- Window headers

The identified LBP surface coatings ranged in condition from good (interior) to poor (exterior).

Polychlorinated Biphenyls (PCBs)

Suspected PCB-containing caulk associated with exterior window and door units in the affected areas of the building were identified with PCB concentrations ranging from 61,500 ppm to 134,000 ppm, exceeding the U.S. Environmental Protection Agency (USEPA) threshold of greater than ($\geq$) 50.0 ppm. At these levels, the PCB-containing caulk/sealant is not considered as an authorized use under the PCB regulations and must be removed. When removed, the caulk/sealant is considered a controlled hazardous waste material under the Toxic Substance Control Act (TSCA).

Potential Hazardous Materials/Wastes and Universal Wastes

Potential hazardous materials, Hazardous Wastes and Universal Wastes were observed on the interior of the building and include:

- Mercury containing fluorescent light bulbs
- Assumed PCB-containing fluorescent light ballasts
- Mercury-containing thermostats
- Emergency exit signs
- Emergency light batteries



TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	i
1.0 INTRODUCTION.....	1
2.0 ASBESTOS-CONTAINING MATERIALS.....	1
2.1 Limited Asbestos Renovation Impact Survey	1
2.2 Asbestos Sampling Results	3
3.0 LEAD-BASED PAINT/LEAD-CONTAINING SURFACE COATING DETERMINATION	3
4.0 POLYCHLORINATED BIPHENYLS (PCBS) CAULK/SEALANT SCREENING	5
5.0 POTENTIAL HAZARDOUS MATERIALS/WASTES AND UNIVERSAL WASTES.....	6
6.0 CONCLUSIONS AND RECOMMENDATIONS	6

FIGURES

First Floor Plan

TABLES

Table 1	Summary of Identified Asbestos-containing Materials
Table 2	Budget Cost Estimate for Asbestos Abatement
Table 3	Summary of Identified PCB-containing Materials
Table 4	Potential Hazardous Materials Inventory and Estimated Remediation Cost

APPENDICES

Appendix A	Asbestos and Lead-Based Paint Risk Assessor Certifications
Appendix B	Asbestos Analytical Laboratory Certifications
Appendix C	Asbestos Laboratory Analytical Results
Appendix D	Lead-Based Paint/Lead-Containing Surface Coating Determination Report
Appendix E	PCB Laboratory Analytical Results
Appendix F	Photographic Log



1.0 INTRODUCTION

Haley Ward, Inc. (Haley Ward) completed a Limited Hazardous Materials Assessment (HMA) on April 17, 2024, to identify and assess hazardous materials on or within the first floor of the commercial building located at 333 Cony Road in Augusta, Maine.

This assessment was completed to identify and assess suspect Asbestos-Containing Materials (ACM), Lead-Based Paint (LBP)/lead-containing surface coatings, Polychlorinated Biphenyls (PCBs), and Potential Hazardous Materials/Wastes and Universal Wastes which would require either special handling and disposal or would be regulated prior to, or during, planned renovations.

The single-story structure located at 333 Cony Road, built circa 1960, consists of a masonry building with brick veneer siding and a flat roof system. The HMA was completed in areas identified by DACF for planned renovation, including:

- Boiler Room
- Restrooms
- Janitor's Closet
- Laboratory and associated closet
- File Storage (Conference) Room
- Laboratory Office
- Two office areas
- Hallway adjacent to above rooms
- Carpenter Shop and Storage area

Room designations are based on a marked up 1961 floor plan provided by DACF.

The boiler room, consisting of two Burnham low pressure boilers which were installed in June 1999, is accessible from the exterior of the building. Pipe insulation present within the boiler room was observed to be fiberglass with PVC elbows.

2.0 ASBESTOS-CONTAINING MATERIALS

2.1 Limited Asbestos Renovation Impact Survey

A limited asbestos renovation impact survey was conducted in accordance with the Maine Department of Environmental Protection (MDEP) Asbestos Management Regulations (06-096 C.M.R. Chapter 425, 2011) to provide information regarding the presence of ACM within the interior and on the exterior of the affected areas of the building, as highlighted by DACF. Ms. Deborah Kasik, a licensed State of Maine asbestos inspector, performed the field survey. A copy of Ms. Kasik's Asbestos Inspector Certification is included in **Appendix A**.

Completion of the limited asbestos renovation impact survey included:



- Visual identification of suspect ACM on the interior of assessed portion of the building.
- Assignment of room numbers for sample and identified ACM location(s).
- Collection of 31 bulk samples of suspected ACM in accordance with MDEP regulations.
- Quantification of ACM identified by laboratory analysis.

As with any scientific study, an asbestos renovation impact survey is subject to a variety of limitations. Limitations to be considered when interpreting the results of this survey include the following:

- A limited asbestos renovation impact survey may not be able to identify all ACM present throughout a facility.
- Variations in building materials used during construction and subsequent renovations.
- Inaccessible units, rooms, and areas within wall cavities, under floors, and above solid ceilings.
- Roof sampling was not included in the Scope of Work for this project.

A total of thirty-one (31) samples of identified suspect ACM were collected from the interior of the assessed areas of the first floor of the building, including:

- Plaster ceiling
- Sheetrock wall material
- Mudded pipe fitting and tee insulation
- Red fire-stop gasket (from boiler rib)
- Boiler gasket
- One type of ceiling tile
- One type of nine-inch by nine-inch (9x9) off-white floor tile with brown flecks and associated black adhesive
- Covebase adhesive
- Gray door caulk
- Window glazing

The number of samples collected was determined by the number of homogeneous sampling areas identified by the inspector. A homogeneous area is a discrete portion of surfacing material, thermal system insulation, or miscellaneous ACM which, based on the inspector's judgment, is uniform in color, texture, and composition and are present on similar building or utility components.

Bulk samples of suspect ACM collected during the survey of the interior and exterior of the building were submitted to EMSL Analytical, Inc. (EMSL) of South Portland, Maine for analysis. Bulk samples were analyzed using the MDEP required analytical methods: "PLM-EPA 600/R-93/116" (for surfacing, thermal system insulation, and cementitious materials),



and “PLM NOB-EPA 600/R-93/116” (for non-friable organically bound materials (NOBs)) (e.g., floor tile, adhesives, and roofing) with “gravimetric reduction.” EMSL’s laboratory is certified to perform asbestos analysis by both the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Industrial Hygiene Association (AIHA). EMSL is a MDEP licensed Asbestos Analytical Laboratory.

Copies of EMSL’s laboratory certifications are included as **Appendix B**. Asbestos laboratory analytical results and chain of custodies are included as **Appendix C**.

2.2 Asbestos Sampling Results

According to MDEP regulations, locations and occurrences of materials that tested positive and are homogenous in nature (similar in color, texture, and composition) are considered as ACM, provided the material contains greater than or equal to ($\geq$) one percent (%) asbestos based on laboratory analysis. A material can only be considered negative for asbestos if analytical results from all representative bulk samples in a group of samples representing a homogenous material indicate an asbestos content of less than ($<$) one percent.

ACM identified by laboratory analysis included:

- 9x9 off white with brown flecks floor tile and associated black adhesive
- Mudded pipe fitting and tee insulation
- Exterior window glazing (around each individual pane of glass).

ACM mudded pipe fitting, and tee insulation are present along the interior block wall system within the assessed areas of the building.

A summary of identified ACM is included in **Table 1**. Sample locations and locations of identified ACM are included in **Figure H101**.

Budgetary cost estimates have been prepared to provide a budget for removal of identified ACM which are included in **Table 2**. These estimates do not include material replacement costs, regulatory agency notification fees, or a contingency. Estimates assume the contractor will be responsible for preparing the asbestos abatement design(s). Regulatory agency notification fees associated with this project will vary depending on phasing and project schedule. Actual abatement costs may vary depending upon the quantity of ACM abated and abatement methods utilized.

3.0 LEAD-BASED PAINT/LEAD-CONTAINING SURFACE COATING DETERMINATION

An LBP/lead-containing surface coating determination was conducted by Ms. Deborah A. Kasik, a MDEP certified Lead Risk Assessor. A copy of Ms. Kasik’s Lead Risk Assessor Certification is included in **Appendix A**. The purpose of the determination was to identify LBP/lead-containing surface coatings, if present, on the interior and/or exterior surfaces of the affected areas identified within the building. The LBP determination was performed



in accordance with the established protocols outlined in the MDEP Lead Management Regulation (06-096 C.M.R. Chapter 424 § 7, 2021) and as applicable to this project. The testing provides information on the lead content and an assessment of the condition of the surfaces tested.

The LBP/lead-containing surface coating testing was conducted using a portable X-Ray Fluorescence (XRF) Lead Paint Analyzer (RMD LPA-1), which non-destructively tests for the presence of LBP or other lead-containing surface coatings. The XRF analyzer is licensed with the Maine Department of Human Services Radiation Control Program and operated in accordance with all applicable regulations and conditions of licensure. The determination as to whether a component contains lead is based upon the MDEP Lead Management Regulation. The MDEP defines a component as lead-containing if the XRF result is ≥ 1.0 milligrams per square centimeter (mg/cm^2). A visual assessment of the existing condition of the identified LBP was also completed at the time of the determination.

Calibration of the equipment is required prior to LBP testing, after every four hours of testing, and at the completion of the testing by regulation. Calibration readings were within the manufacturer's recommended range.

LBP/lead-containing surface coatings were identified on interior surfaces of the assessed areas including:

Interior

- Lower ceramic tile walls in restrooms
- Glazed ceramic block wall in hallway (to right of exit door) – glazed ceramic block wall
- Glazed ceramic block wall in laboratory and associated closet
- Glazed ceramic block wall in laboratory office

Exterior

- Door header to Boiler Room
- Door header to Hallway
- Window headers

An LBP/lead-containing surface coatings determination report is included as **Appendix D**. A summary of the compiled XRF results is presented in the following table.



CLASSIFICATION OF COMPILED XRF RESULTS

BUILDING COMPONENTS	COMPILED XRF READING CLASSIFICATION
Walls (Drywall)	Negative
Walls (CMU block)	Negative
Walls (glazed block)	Positive
Lower Restroom Walls (glazing on ceramic tiles)	Positive
Ceiling (plaster; boiler room)	Negative
Ceramic Floors	Negative
Entry Door, Casing, Jamb	Negative
Heaters	Negative
Trim on Moveable Walls	Negative
Window units interior/exterior (metal)	Negative
Windowsills (wood)	Negative
Corrugated metal ceiling	Negative
Structural Steel	Negative
Exterior door and window system headers	Positive

4.0 POLYCHLORINATED BIPHENYLS (PCBS) CAULK/SEALANT SCREENING

PCBs were used as a plasticizer in caulk and in elastic sealant materials, primarily from 1950 through 1978. These caulk/sealants were commonly used in windows and associated window systems, door frames, stairways, masonry columns and other masonry materials. PCBs were not used in these materials after 1978. Consistent with U.S. Environmental Protection Agency (USEPA) guidelines, PCB-containing caulk has a PCB content of ≥ 50.0 parts per million (ppm). At this level, the caulk containing PCBs is not authorized for use under USEPA regulations and must be removed. When removed, these materials are considered a controlled hazardous waste material under the Toxic Substance Control Act (TSCA).

Haley Ward collected four representative caulk samples associated with exterior window and door systems in the assessed areas including:

- Gray caulk associated with door casing (metal to clay masonry brick)
- White caulk associated with window casing (metal to clay masonry brick; boiler room)
- Gray caulk associated with windowsill (metal to concrete)
- White caulk associated with window casing (metal to clay masonry brick; typical front windows)



Caulk samples were analyzed by Alpha Analytical of Westborough, Massachusetts, using USEPA Method SW-846 3540C (Soxhlet).

Suspected PCB-containing caulk associated with exterior window and door units in the affected areas of the building were identified with PCB concentrations ranging from 61,500 ppm to 134,000 ppm, exceeding the U.S. Environmental Protection Agency (USEPA) threshold of greater than ($\geq$) 50.0 ppm. At these levels, the PCB-containing caulk/sealant is not considered as an authorized use under the PCB regulations and must be removed. When removed, the caulk/sealant is considered a controlled hazardous waste material under the Toxic Substance Control Act (TSCA).

A summary of PCB laboratory analytical results is included in **Table 3**. Laboratory analytical results are included as **Appendix E**. Sample locations of representative caulk samples are included in **Figure H101**. A photographic log of sampled hazardous materials is included as **Appendix F**.

5.0 POTENTIAL HAZARDOUS MATERIALS/WASTES AND UNIVERSAL WASTES

Potential hazardous materials, Hazardous Wastes and Universal Wastes were observed on the interior of the building and include:

- Mercury containing fluorescent light bulbs
- Assumed PCB-containing fluorescent light ballasts
- Mercury-containing thermostats
- Emergency exit signs
- Emergency light batteries

6.0 CONCLUSIONS AND RECOMMENDATIONS

This investigation revealed the following relevant information:

Asbestos-Containing Materials (ACM)

ACM identified by laboratory analysis included:

- 9x9 off-white floor tile with brown flecks and associated ACM black adhesive.
- Mudded pipe fitting and tees insulation on non-ACM fiberglass-insulated lines.
- Exterior window glazing (around each individual pane of glass in window system)

Current state regulations require that identified ACM which may be impacted by planned renovation/demolition activity be removed by a MDEP licensed asbestos abatement contractor in accordance with applicable state and federal regulations prior to disturbance by such planned activities. In accordance with National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61), State of Maine, MDEP, and Asbestos Management Regulations (06-096 C.M.R. Chapter 425, 2011), a contractor conducting a renovation and/or demolition activity that would disturb regulated ACM



must: (1) notify the U.S. Environmental Protection Agency (USEPA) Administrator and the MDEP of such activities, (2) use proper removal procedures, (3) use proper engineering controls to limit emissions of asbestos fibers, and (4) utilize proper waste disposal. If any hidden suspect ACM (behind walls, in chases, above permanent ceilings, etc.) is uncovered during renovation or demolition activities, work must be stopped, and the material tested for asbestos content. All ACM must be disposed of in accordance with all applicable state and federal requirements.

Lead-Based Paint/Lead-Containing Surface Coatings

LBP/lead-containing surface coatings were identified on the interior of the assessed areas of the building, including:

Interior

- Lower ceramic tile walls in restrooms
- Glazed ceramic block wall in hallway (to right of exit door) – glazed ceramic block wall
- Glazed ceramic block wall in laboratory and associated closet
- Glazed ceramic block wall in laboratory office

Exterior

- Door header to Boiler Room
- Door header to Hallway
- Window headers

Under current state and federal regulations for non-residential structures, LBP does not have to be removed from a structure prior to demolition, renovation, or removal of specific building components. However, the following regulations/requirements must be followed in relation to disturbance of LBP during renovation or demolition.

- OSHA 29 CFR 1926.62 requires that an employer protect employees from exposure to lead dust during renovation or demolition activities. While primarily an issue for the demolition or abatement contractor, the Owner is responsible to notify all parties involved in the work of the knowledge or presumption that interior and exterior painted surfaces may contain lead.
- The MDEP requires that building components with LBP be disposed of in a licensed Construction and Demolition (C&D) Landfill, and that a manifest documenting the transport and disposal of this material be provided to the Owner.
- LBP removed (e.g., scrapped, chipped) from surfaces must be analyzed using a Toxicity Characteristic Leaching Procedure (TCLP) test to determine whether the residue is considered a hazardous waste. If TCLP results indicate levels of leachable lead in excess of 5.0 parts per million (ppm), the resulting waste must be disposed of as a hazardous material.



PCB Sample Screening

Caulk with PCB concentrations ≥ 50 ppm was identified associated with exterior windows and doors in the DACF building. At or above this threshold concentration, the PCB-containing caulk/sealant is not considered as an authorized use under the PCB regulations and must be properly removed. When removed, the caulk/sealant is considered a controlled hazardous waste material under the Toxic Substance Control Act (TSCA).

PCB-containing caulk was identified on two door systems within the assessed areas of the building, including the door to the boiler room and hallway. The PCB-containing caulk was identified around the window systems in the following rooms:

- Boiler Room
- Restrooms
- Laboratory and associated closet
- File Storage (Conference) Room
- Laboratory Office
- Two office areas

Potential Hazardous Materials, Hazardous Wastes and Universal Wastes

Potential Hazardous Materials, Hazardous Wastes and Universal Wastes were observed on the interior of the building and include:

- Mercury containing fluorescent light bulbs
- Assumed PCB-containing light ballasts
- Mercury-containing thermostats
- Emergency exit signs
- Emergency light batteries

When removed from fixtures for disposal, fluorescent light bulbs are considered a Universal Waste and must be properly handled, packaged, and disposed of under current MDEP regulations (06-096 C.M.R. Chapter 858 (2018)). Fluorescent light ballasts contain capacitors that may be filled with PCB-containing dielectric fluid; however, it is unknown whether PCB ballasts (a Universal Waste) are present in the building. The recommended Best Management Practice is to individually remove each light fixture and have individual ballasts evaluated to confirm the presence or absence of PCBs. Non-PCB light ballasts will be clearly labeled as not containing PCBs and may be disposed of as solid waste. If no such labeling is present, the ballast should be assumed to be PCB-containing and be segregated and handled as Universal Waste. Emergency exit signs, light batteries, and mercury-containing thermostats should be removed and properly disposed.



7.0 REPORT CERTIFICATION

This report was prepared and reviewed by Haley Ward for the use of the State of Maine Department of Agriculture, Conservation, and Forestry and should not be reproduced without their full, written authorization.

Deborah A. Kasik

Project Scientist II

MDEP Certified Asbestos Inspector License No. AI-0177

MDEP Certified Lead Risk Assessor License No. LR-0003

Michael D. Sauda, MPH, CSP

Senior Project Manager II

DAK/MDS/lmb
Attachments



FIGURE



TABLES



TABLE 1 | SUMMARY OF IDENTIFIED ASBESTOS-CONTAINING MATERIALS (ACM)
DEPARTMENT OF AGRICULTURE, CONSERVATION, AND FORESTRY
333 CONY ROAD, AUGUSTA, MAINE

Room Section/Number	Sample #: CR-	ACM Mudded Pipe Fitting Insulation (EA)	ACM Mudded Pipe Fitting Insulation above Ceiling Tiles (EA)	ACM 9x9 Off-White w/Brown Flecks Floor Tile (SF)	ACM 9x9 Off-White w/Brown Flecks Floor Tile beneath Carpet (SF)	ACM Window Glazing (EA)	Comment
FIRST FLOOR							
Men's Room	011A		1				Residual debris on fitting
Ladies Room	011A		2				
Hallway	011A	3					
	011A		11				
	008A 009A			290			
Laboratory	011A		9				
	008A 009A			400			
File Storage (Conference)	011A	1					
	011A		12				
	008A 009A			520			Includes closet
Lab Office	008A 009A				120		
Office No. 1	011A		7				
	008A 009A			480			Includes area in front of Lab Office
Office	011A		1				
	008A 009A				200		
Carpentry Shop and Storage	011A		24				
EXTERIOR							
Window Glazing	005A					14	
TOTALS:		4	67	1690	320	14	

TABLE 2 | ESTIMATED ASBESTOS ABATEMENT COSTS
DEPARTMENT OF AGRICULTURE, CONSERVATION AND FORESTRY
333 CONY ROAD, AUGUSTA, MAINE



Identified ACM	Total Estimated Quantity	Unit Cost	Estimated Abatement Cost
ACM Mudded Pipe Fitting Insulation (EA)	28	\$100	\$ 2,800
ACM Mudded Pipe Fitting Insulation above Ceiling Tiles (EA)	43	\$100	\$ 4,300
ACM 9x9 Off-White Floor Tile and Associated ACM Black Adhesive	1,690	\$15	\$ 25,350
ACM 9x9 Off-White Floor Tile and Associated ACM Black Adhesive beneath Carpet	320	\$15	\$ 4,800
Window Glazing (EA)	14	\$250	\$ 3,500
TOTAL			\$ 40,750

Note:
 SF = Square Feet
 LF = Linear Feet
 EA = Each

TABLE 3 | SUMMARY OF PCB LABORATORY ANALYTICAL RESULTS
DEPARTMENT OF AGRICULTURE, CONSERVATION, AND FORESTRY
333 CONY ROAD, AUGUSTA, MAINE



Sample Number	Location	Date Sampled	Lab Results (ppm)	Notes
PCB-001A	Exterior - Boiler Room Access Door Casing	4/17/2024	63,700	Gray Caulk; Boiler Room Door
PCB-002A	Exterior - Boiler Room Window Casing	4/17/2024	134,000	White Caulk; Window Casing
PCB-003A	Exterior - Boiler Room Window Sill	4/17/2024	61,500	Gray Caulk; Window Sill
PCB-004A	Exterior - Typical Front Window Casings	4/17/2024	131,000	White Caulk; Window Casing

Note:
 SF = Square Feet
 LF = Linear Feet
 EA = Each



TABLE 4
HAZARDOUS MATERIALS INVENTORY
DEPT. OF AGRICULTURE, CONSERVATION AND FORESTRY
333 CONY ROAD
AUGUSTA, MAINE

Identified Hazardous Materials	Quantity (Each)	Quantity Per Unit	Total Estimated Quantity	Unit Cost	Estimated Remediation Cost
Fluorescent Light Tubes - 4 foot	115	4 LF/EA	460	\$0.30	\$ 138
Fluorescent Light Tubes - 8 foot	4	8 LF/EA	32	\$0.30	\$ 10
LED - Light Bulbs	4	1 EA	4	\$0.30	\$ 1
Suspect PCB-Containing Light Ballasts	50	1 EA	50	\$4.50	\$ 225
Mercury-containing Thermostat	5	1 EA	5	\$6.00	\$ 30
Exit Light Signs/Batteries	1	1 EA	1	\$4.50	\$ 5
Emergency Light Batteries	1	1 EA	1	\$4.50	\$ 5
Sub-Total					\$ 413
Transportation (per pickup)	1	-	-	\$1,250	\$ 1,250
Labor (Man-Days)	2	-	-	\$650	\$ 1,300
Sub-Total					\$ 2,550
TOTAL					\$ 2,963

Note:

*U-shaped bulbs counted as two each due to size

LF = Linear Feet

EA = Each

lb= Pound



APPENDIX A

ASBESTOS AND LEAD-BASED PAINT RISK ASSESSOR CERTIFICATIONS



JANET T. MILLS
GOVERNOR

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION



MELANIE LOYZIM
COMMISSIONER

December 5, 2023

Haley Ward, Inc.
One Merchants Plaza Suite 701
Bangor, Maine 04401

Dear Licensee:

Asbestos application(s) for individual certification of the **two** employee(s) listed below have been received and **approved**. Individual certification numbers are listed below and wallet card(s) are enclosed. Card(s) are property of the individual to whom each is issued. Your responsibility as a licensee is to ensure delivery of the cards to persons in your employment. This letter should be retained for your company files as a record of certification. **Please attach 1 updated passport size photo with every application.**

Remember, in Maine all **certified employees** working on an asbestos abatement project, whether conducting removal/repair, air monitoring, design, inspection, or analysis functions, **must work for a State of Maine licensed asbestos firm** and carry his/her wallet card(s) on the job site.

As a reminder, prior to renewing your asbestos certification, the State of Maine **requires** an annual refresher course to be taken before submitting a renewal application. A certificate shall expire one year from the last day of the month from the date of issuance, **or on the last day of the month that the training certificate expires**, whichever is sooner.

All our asbestos forms can be found at <https://www.maine.gov/dep/waste/asbestos/forms.html>
Thank you for your cooperation and your completed application(s).

Name	Category	Certification #	Exp. Date
Deborah A. Kasik	Inspector	AI-0177	11/30/2024
Dennis B. Kingman, Jr.	Inspector	AI-0034	11/30/2024

Sincerely,

Sandra J. Moody, Environmental Specialist
Division of Remediation
Bureau of Remediation and Waste Management

AUGUSTA
17 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0017
(207) 287-7688 FAX: (207) 287-7826

BANGOR
106 HOGAN ROAD, SUITE 6
BANGOR, MAINE 04401
(207) 941-4570 FAX: (207) 941-4584

PORTLAND
312 CANAL
PORTLAND, MAINE 04101
(207) 822-2222

website: www.maine.gov/dep

State of Maine
Asbestos Abatement Program

Deborah A. Kasik

Inspector

Cert No. AI-0177
Trn.Exp.Date 11/09/2024
Expiration Date **11/30/2024**

This is not a legal form of official identification



STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JANET T. MILLS
GOVERNOR

MELANIE LOYZIM
COMMISSIONER

January 21, 2024

Attn: Deborah A. Kasik
Haley Ward, Inc.
One Merchant's Plaza Suite 701
Bangor, Maine 04401

Dear Ms. Kasik,

Your lead application for certification has been received and **approved**. You have been granted certification as a **Lead Risk Assessor LR-0003**. Enclosed is your wallet card, with an expiration date of **January 4, 2025**. All employees working on a lead abatement project must carry this photo ID wallet card. The card is property of the individual to whom it is issued. Your responsibility as a licensee is to ensure delivery of the card to person in your employment. This letter should be retained for your company files as record of certification. **Please attach 1 updated passport size photo with every application.**

Thank you for your cooperation and your completed application(s). Applications can now be found on our DEP webpage at the following:

<https://www.maine.gov/dep/waste/lead/forms/index.html>

If you have any questions on this certification or on any other aspect of DEP's lead abatement licensing program, please call Sandy Moody (207) 242-0877 or email sandy.j.moody@maine.gov

Sincerely,

Sandra J. Moody, Environmental Specialist
Division of Remediation
Bureau of Remediation and Waste Management

Enclosure



AUGUSTA
17 STATE HOUSE STATION
AUGUSTA, MAINE 04333-0017
(207) 287-7688 FAX: (207) 287-7826
RAY BLDG., HOSPITAL ST.

BANGOR
106 HOGAN ROAD, SUITE 6
BANGOR, MAINE 04401
(207) 941-4570 FAX: (207) 941-4584

PORTLAND
312 CANCO ROAD
PORTLAND, MAINE 04103
(207) 822-6300 FAX: (207) 822-6303

PRESQUE ISLE
1235 CENTRAL DRIVE, SKYWAY PARK
PRESQUE ISLE, MAINE 04679-2094
(207) 764-0477 FAX: (207) 760-3143



APPENDIX B

ASBESTOS ANALYTICAL LABORATORY CERTIFICATIONS



STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JANET T. MILLS
GOVERNOR

MELANIE LOYZIM
COMMISSIONER

September 2, 2023

Attn: Lorie Dennis, QA Certification Coordinator
EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077

Dear Ms. Dennis,

This is to confirm that the Maine Department of Environmental Protection is in receipt of your request to add the following labs to your licensing of Analytical Laboratories: Boston, MA., South Portland, Maine, Wallingford, CT and Carle Place, NY.

LA-0038 for Asbestos Analytical Laboratory (Air), expires on 10/31/2024
LB-0039 for Asbestos Analytical Laboratory (Bulk), expires on 10/31/2024

Remember each laboratory must have certified individual(s) within the lab to perform analyses.

If you need any further assistance please feel free to contact me at (207) 242-0877 or e-mail at sandy.j.moody@maine.gov.

Sincerely,

Sandra J. Moody, Environmental Specialist
Division of Remediation
Bureau of Remediation and Waste Management



State of Maine
Department of Environmental Protection

LICENSE

EMSL Analytical, Inc.

Asbestos Analytical Laboratory
(Air)

License Number: **LA-0038**

Expiration Date: **10/31/2024**



State of Maine
Department of Environmental Protection

LICENSE

EMSL Analytical, Inc.

Asbestos Analytical Laboratory
(Bulk)

License Number: LB-0039

Expiration Date: 10/31/2024

S. PORTLAND - INDIVIDUAL ANALYST CERTIFICATIONS

State of Maine

October 30, 2023

<i>Employee Name</i>	<i>Lab Location</i>	<i>State Certified</i>	<i>Certification No.</i>	<i>Type of Cert.</i>	<i>Exp. Date</i>
Stephen Severn	S. Portland	Maine	AA-0497	Air Asbestos Analyst	10/31/2024
Stephen Severn	S. Portland	Maine	BA-0178	Bulk Asbestos Analyst	10/31/2024
Stefan Reis	S. Portland	Maine	BA-0233	Bulk Asbestos Analyst	5/31/2024

United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 500094-0

EMSL Analytical, Inc.

South Portland, ME

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

Asbestos Fiber Analysis

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2023-10-01 through 2024-09-30

Effective Dates



A handwritten signature in blue ink, reading "Dana S. Laman".

For the National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

EMSL Analytical, Inc.

161 John Roberts Road
South Portland, ME 04106
Stephen Severn
Phone: 207-517-6921
Email: ssevern@emsl.com
<http://www.emsl.com>

ASBESTOS FIBER ANALYSIS

NVLAP LAB CODE 500094-0

Bulk Asbestos Analysis

Code

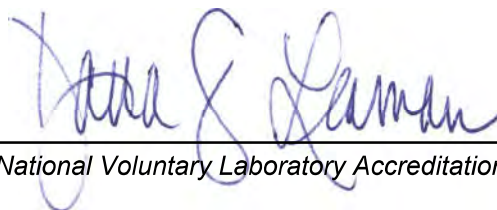
Description

18/A01

EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples

18/A03

EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials



For the National Voluntary Laboratory Accreditation Program



AIHA Laboratory Accreditation Programs, LLC

acknowledges that

EMSL Analytical, Inc.

200 Route 130 North Cinnaminson, NJ 08077

Laboratory ID: LAP-100194

along with all premises from which key activities are performed, as listed above, has fulfilled the requirements of the AIHA Laboratory Accreditation Programs (AIHA LAP), LLC accreditation to the ISO/IEC 17025:2017 international standard, General Requirements for the Competence of Testing and Calibration Laboratories in the following:

LABORATORY ACCREDITATION PROGRAMS

☒	INDUSTRIAL HYGIENE	Accreditation Expires: January 01, 2025
☒	ENVIRONMENTAL LEAD	Accreditation Expires: January 01, 2025
☒	ENVIRONMENTAL MICROBIOLOGY	Accreditation Expires: January 01, 2025
☐	FOOD	Accreditation Expires:
☐	UNIQUE SCOPES	Accreditation Expires:

Specific Field(s) of Testing (FoT)/Method(s) within each Accreditation Program for which the above named laboratory maintains accreditation is outlined on the attached Scope of Accreditation. Continued accreditation is contingent upon successful on-going compliance with ISO/IEC 17025:2017 and AIHA LAP, LLC requirements. This certificate is not valid without the attached Scope of Accreditation. Please review the AIHA LAP, LLC website (www.aihaaccreditedlabs.org) for the most current Scope.

A handwritten signature in black ink that reads 'Cheryl O. Morton'.

Cheryl O Morton
Managing Director, AIHA Laboratory Accreditation Programs, LLC



AIHA Laboratory Accreditation Programs, LLC

SCOPE OF ACCREDITATION

EMSL Analytical, Inc.

200 Route 130 North Cinnaminson, NJ 08077

Laboratory ID: LAP-100194

Issue Date: 01/01/2023

The laboratory is approved for those specific field(s) of testing/methods listed in the table below. Clients are urged to verify the laboratory's current accreditation status for the particular field(s) of testing/Methods, since these can change due to proficiency status, suspension and/or withdrawal of accreditation.

Industrial Hygiene Laboratory Accreditation Program (IHLAP)

Initial Accreditation Date: 02/01/1989

IHLAP Scope Category	Field of Testing (FOT)	Technology sub-type/Detector	Published Reference Method/Title of In-house Method	Component, parameter or characteristic tested
Asbestos/Fiber Microscopy Core	Phase Contrast Microscopy (PCM)	-	NIOSH 7400	Asbestos/Fibers
Asbestos/Fiber Microscopy Core	Polarized Light Microscopy (PLM)	-	EPA 600/R-93/116	Asbestos & Other Fibers in Bulk
Asbestos/Fiber Microscopy Core	Transmission Electron Microscopy (TEM)	-	EPA AHERA - 40 CFR Part 763	Asbestos
Asbestos/Fiber Microscopy Core	Transmission Electron Microscopy (TEM)	-	NIOSH 7402	Asbestos/Fibers
Chromatography Core	GC/MS	-	EPA TO-15	Volatile Organic Compounds
Chromatography Core	Gas Chromatography	GC/ECD	NIOSH 5502 Modified	Aldrin & Lindane
Chromatography Core	Gas Chromatography	GC/ECD	NIOSH 5503 Modified	Polychlorinated biphenyls
Chromatography Core	Gas Chromatography	GC/ECD	NIOSH 5510 Modified	Chlordane
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1003 Modified	Halogenated Hydrocarbons
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1005 Modified	Methylene Chloride
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1400 Modified	Alcohols
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1500 Modified	Hydrocarbons
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1501 Modified	Aromatic Hydrocarbons
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1550 Modified	Total Petroleum Hydrocarbons
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 1603 Modified	Acetic Acid
Chromatography Core	Gas Chromatography	GC/FID	NIOSH 2000 Modified	Methyl Alcohol
Chromatography Core	Gas Chromatography (Diffusive Samplers)	-	NIOSH 1501	Aromatic Hydrocarbons

Effective: 06/07/2022

Revision: 9.2

Page 1 of 2



IHLAP Scope Category	Field of Testing (FOT)	Technology sub-type/Detector	Published Reference Method/Title of In-house Method	Component, parameter or characteristic tested
Chromatography Core	Ion Chromatography (IC)	-	NIOSH 6004 Modified	Sulfur Dioxide/Sulfate
Chromatography Core	Ion Chromatography (IC)	-	NIOSH 6011	Chlorine & Bromine
Chromatography Core	Ion Chromatography (IC)	-	NIOSH 7903	Inorganic Acids
Chromatography Core	Ion Chromatography (IC)	-	OSHA ID-214	Ozone
Chromatography Core	Ion Chromatography (IC)	-	OSHA ID-215 (Version 2) Modified	Hexavalent Chromium
Chromatography Core	Liquid Chromatography	HPLC/FL	NIOSH 2016	Formaldehyde
Chromatography Core	Liquid Chromatography	HPLC/UV	NIOSH 5506 Modified	Polynuclear Aromatic Hydrocarbons (PAHs)
Chromatography Core	Liquid Chromatography	LC/MS	NIOSH 9111 Modified	Methamphetamines
Miscellaneous Core	Gravimetric	-	NIOSH 0500	Total Dust
Miscellaneous Core	Gravimetric	-	NIOSH 0600	Respirable Dust
Miscellaneous Core	Gravimetric	-	NIOSH 5524	Metal Working Fluids
Miscellaneous Core	Thermo-optical Analysis (TOA)	-	NIOSH 5040	Elemental Carbon
Spectrometry Core	Atomic Absorption	CVAA	NIOSH 6009 Modified	Mercury
Spectrometry Core	Atomic Absorption	CVAA	OSHA ID-140 Modified	Mercury vapor
Spectrometry Core	Atomic Absorption	CVAA	OSHA ID-145	Mercury particulate
Spectrometry Core	Atomic Absorption	FAA	NIOSH 7082	Lead
Spectrometry Core	Inductively-Coupled Plasma	ICP/AES	NIOSH 7300 Modified	Lead
Spectrometry Core	Inductively-Coupled Plasma	ICP/MS	NIOSH 7300 Modified	Lead
Spectrometry Core	UV/VIS (Colorimetric)	-	NIOSH 6010	Hydrogen Cyanide
Spectrometry Core	X-ray Diffraction (XRD)	-	NIOSH 7500	Silica
Spectrometry Core	X-ray Diffraction (XRD)	-	OSHA ID-142	Silica

A complete listing of currently accredited IHLAP laboratories is available on the AIHA LAP, LLC website at: <http://www.aihaaccreditedlabs.org>



APPENDIX C

ASBESTOS LABORATORY ANALYTICAL RESULTS



EMSL Analytical, Inc.

161 John Roberts Road South Portland, ME 04106
Phone/Fax: (207) 517-6921 / (207) 517-6922
<http://www.EMSL.com> / portlandlab@emsl.com

EMSL Order ID: 622400336
Customer ID: CESI62
Customer PO:
Project ID:

Attn: Deb Kasik
Haley Ward
1 Merchant's Plaza
7th Floor
Bangor, ME 04401
Proj: 10720.005

Phone: (207) 989-4824
Fax: (207) 989-4881
Collected: 4/17/2024
Received: 4/19/2024
Analyzed: 4/24/2024

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CR-001A **Lab Sample ID:** 622400336-0001
Sample Description: BOILER ROOM/PLASTER CEILING

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	5.0%	95.0%	None Detected	

Client Sample ID: CR-001B **Lab Sample ID:** 622400336-0002
Sample Description: BOILER ROOM/PLASTER CEILING

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	5.0%	95.0%	None Detected	

Client Sample ID: CR-001C **Lab Sample ID:** 622400336-0003
Sample Description: BOILER ROOM/PLASTER CEILING

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	5.0%	95.0%	None Detected	

Client Sample ID: CR-002A **Lab Sample ID:** 622400336-0004
Sample Description: BOILER ROOM B#2/RED FIRE STOP (GASKET) - FIRE STOP

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Red	0.0%	100%	None Detected	

Client Sample ID: CR-002B **Lab Sample ID:** 622400336-0005
Sample Description: BOILER ROOM B#2/RED FIRE STOP (GASKET) - FIRE STOP

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Red	0.0%	100%	None Detected	

Client Sample ID: CR-002C **Lab Sample ID:** 622400336-0006
Sample Description: BOILER ROOM B#2/RED FIRE STOP (GASKET) - FIRE STOP

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Red	0.0%	100%	None Detected	

Client Sample ID: CR-003A **Lab Sample ID:** 622400336-0007
Sample Description: BOILER ROOM B#1/GASKET - GASKET

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Brown/Black	0.0%	100%	None Detected	



EMSL Analytical, Inc.

161 John Roberts Road South Portland, ME 04106
Phone/Fax: (207) 517-6921 / (207) 517-6922
<http://www.EMSL.com> / portlandlab@emsl.com

EMSL Order ID: 622400336
Customer ID: CESI62
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CR-004A **Lab Sample ID:** 622400336-0008

Sample Description: EXT DOOR TO BOILER RM/GRAY CAULK - CAULK

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Gray	0.0%	100%	None Detected	

Client Sample ID: CR-004B **Lab Sample ID:** 622400336-0009

Sample Description: EXT DOOR TO BOILER RM/GRAY CAULK - CAULK

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Gray	0.0%	100%	None Detected	

Client Sample ID: CR-004C **Lab Sample ID:** 622400336-0010

Sample Description: EXT DOOR TO BOILER RM/GRAY CAULK - CAULK

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Gray	0.0%	100%	None Detected	

Client Sample ID: CR-005A **Lab Sample ID:** 622400336-0011

Sample Description: EXTERIOR BOILER RM/WINDOW GLAZING - GLAZING

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Gray	0.0%	97.8%	2.2% Chrysotile	

Client Sample ID: CR-005B **Lab Sample ID:** 622400336-0012

Sample Description: EXTERIOR BOILER RM/WINDOW GLAZING - GLAZING

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024				Positive Stop (Not Analyzed)	

Client Sample ID: CR-005C **Lab Sample ID:** 622400336-0013

Sample Description: EXTERIOR BOILER RM/WINDOW GLAZING - GLAZING

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024				Positive Stop (Not Analyzed)	

Client Sample ID: CR-006A **Lab Sample ID:** 622400336-0014

Sample Description: MEN'S ROOM/CT 4X2 FISSURE W/ PINHOLE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	95.0%	5.0%	None Detected	

Client Sample ID: CR-006B **Lab Sample ID:** 622400336-0015

Sample Description: HALLWAY/CT 4X2 FISSURE W/ PINHOLE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	95.0%	5.0%	None Detected	



EMSL Analytical, Inc.

161 John Roberts Road South Portland, ME 04106
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<http://www.EMSL.com> / portlandlab@emsl.com

EMSL Order ID: 622400336
Customer ID: CESI62
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CR-006C **Lab Sample ID:** 622400336-0016

Sample Description: OFFICE/CT 4X2 FISSURE W/ PINHOLE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	95.0%	5.0%	None Detected	

Client Sample ID: CR-007A **Lab Sample ID:** 622400336-0017

Sample Description: HALLWAY/COVEBASE ADHESIVE - COVEBASE ADHESIVE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Brown	0.0%	100%	None Detected	

Client Sample ID: CR-007B **Lab Sample ID:** 622400336-0018

Sample Description: HALLWAY/COVEBASE ADHESIVE - COVEBASE ADHESIVE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Brown	0.0%	100%	None Detected	

Client Sample ID: CR-007C **Lab Sample ID:** 622400336-0019

Sample Description: HALLWAY/COVEBASE ADHESIVE - COVEBASE ADHESIVE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Brown	0.0%	100%	None Detected	

Client Sample ID: CR-008A **Lab Sample ID:** 622400336-0020

Sample Description: HALLWAY (NEAR DOOR TO EXIT)/9" FT OFF-WHITE W/ BROWN FLECKS - FLOOR TILE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Beige	0.0%	98.0%	2.0% Chrysotile	

Client Sample ID: CR-008B **Lab Sample ID:** 622400336-0021

Sample Description: FILE STORAGE/9" FT OFF-WHITE W/ BROWN FLECKS - FLOOR TILE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024				Positive Stop (Not Analyzed)	

Client Sample ID: CR-008C **Lab Sample ID:** 622400336-0022

Sample Description: LAB/9" FT OFF-WHITE W/ BROWN FLECKS - FLOOR TILE

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024				Positive Stop (Not Analyzed)	

Client Sample ID: CR-009A **Lab Sample ID:** 622400336-0023

Sample Description: HALLWAY (NEAR DOOR TO EXIT)/BLACK MASTIC (FT) - MASTIC

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024	Black	0.0%	92.7%	7.3% Chrysotile	



EMSL Analytical, Inc.

161 John Roberts Road South Portland, ME 04106
Phone/Fax: (207) 517-6921 / (207) 517-6922
<http://www.EMSL.com> / portlandlab@emsl.com

EMSL Order ID: 622400336
Customer ID: CESI62
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CR-009B Lab Sample ID: 622400336-0024

Sample Description: FILE STORAGE/BLACK MASTIC (FT) - MASTIC

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024				Positive Stop (Not Analyzed)	

Client Sample ID: CR-009C Lab Sample ID: 622400336-0025

Sample Description: LAB/BLACK MASTIC (FT) - MASTIC

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM Grav. Reduction	4/24/2024				Positive Stop (Not Analyzed)	

Client Sample ID: CR-010A Lab Sample ID: 622400336-0026

Sample Description: OFFICE/SHEETROCK

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CR-010B Lab Sample ID: 622400336-0027

Sample Description: OFFICE/SHEETROCK

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CR-010C Lab Sample ID: 622400336-0028

Sample Description: OFFICE/SHEETROCK

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	0.0%	100.0%	None Detected	

Client Sample ID: CR-011A Lab Sample ID: 622400336-0029

Sample Description: HALLWAY/MUDDIED PIPE FITTING

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	0.0%	50.0%	50% Chrysotile	

Client Sample ID: CR-011B Lab Sample ID: 622400336-0030

Sample Description: FILE STORAGE (NEAR FLOOR)/MUDDIED PIPE FITTING

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	0.0%	50.0%	50% Chrysotile	

Client Sample ID: CR-011C Lab Sample ID: 622400336-0031

Sample Description: FILE STORAGE (ABOVE CT)/MUDDIED PIPE FITTING

TEST	Analyzed Date	Color	Non-Asbestos		Asbestos	Comment
			Fibrous	Non-Fibrous		
PLM	4/24/2024	Gray	0.0%	50.0%	50% Chrysotile	



EMSL Analytical, Inc.

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<http://www.EMSL.com> / portlandlab@emsl.com

EMSL Order ID: 622400336
Customer ID: CESI62
Customer PO:
Project ID:

Summary Test Report for Asbestos Analysis of Bulk Material

PLM: ME CERT # BA-0233

PLM EPA NOB: ME CERT # BA-0233

Analyst(s):

Stephen Severn PLM (12)
PLM Grav. Reduction (13)

Reviewed and approved by:

Stephen Severn, Technical Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This is a summary report; official reports are available on LabConnect or upon request and relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. South Portland, ME NVLAP Lab Code 500094-0, VT AL197271, ME LM-0039, CT PH-0346, AZ AZ-0959, MA AA000236

Report amended: 04/29/2024 15:34:30 Replaces initial report from: 04/25/2024 10:34:03 Reason Code: Client-Other (see report comment)

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

622400336

South Portland, ME 04106

PHONE: (207) 517-6921

EMAIL: portlandlab@emsl.com

Customer Information	Customer ID:	CESI62		Billing Information	Billing ID:		
	Company Name:	Haley Ward			Company Name:	Haley Ward	
	Contact Name:	Deb Kasik			Billing Contact:	Deb Kasik	
	Street Address:	1 Merchant's Plaza 7th Floor, Suite 701			Street Address:	1 Merchant's Plaza, 7th Floor	
	City, State, Zip:	Bangor	ME 04401		Country:	US	City, State, Zip:
	Phone:	207-989-4824			Phone:	207-989-4824	
	Email(s) for Report:	dkasik@haleyward.com			Email(s) for Invoice:	joreskovich@haleyward.com	
Project Information							
Project Name/No: 10720.005				Purchase Order:			
EMSL LIMS Project ID: (If applicable, EMSL will provide)				US State where samples collected: ME			
Sampled By Name: Deb Kasik				State of Connecticut (CT) must select project location: ☐ Commercial (Taxable) ☐ Residential (Non-Taxable)			
Sampled By Signature: <i>Deborah A. Kasik</i>				Date Sampled: 4/17/24			
				No. of Samples in Shipment: 31			
Turn-Around-Time (TAT)							
☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 32 Hour ☐ 48 Hour ☐ 72 Hour ☒ 96 Hour ☐ 1 Week ☐ 2 Week							
Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only; samples must be submitted by 11:30am.							
Test Selection							
PLM - Bulk (reporting limit)							
☒ PLM EPA 600/R-93/116 (<1%)							
☒ PLM EPA NOB (<1%)							
☐ POINT COUNT							
☐ 400 (<0.25%) ☐ 1,000 (<0.1%)							
☐ POINT COUNT w/ GRAVIMETRIC							
☐ 400 (<0.25%) ☐ 1,000 (<0.1%)							
☐ NIOSH 9002 (<1%)							
☐ NYS 198.1 (Friable - NY)							
☐ NYS 198.6 NOB (Non-Friable - NY)							
☐ NYS 198.8 (Vermiculite SM-V)							
TEM - Bulk							
☐ TEM EPA NOB							
☐ NYS NOB 198.4 (Non-Friable - NY)							
☐ TEM EPA 600/R-93/116 w Milling Prep (0.1%)							
Other Tests (please specify)							
See Note on pg 2 regarding analyzing all ABC (all 3) samples							
☒ Positive Stop - Clearly Identified Homogeneous Areas (HA)							
Sample Number	HA Number	Sample Location		Material Description			
CR-001A		Boiler Rm		Plaster Ceiling			
B		"		"			
C		"		"			
CR-002A		Boiler Rm		B#2	Red fire stop (gasket)		
B		"		"	"		
C		"		"	"		
CR-003A		Boiler Rm		B#1	gasket		
CR-004A		Ext Door to Boiler Rm			Gray caulk		
B		"			"		
C		"			"		
RECEIVED							
Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)							
NOB per MEDEP							
APR 19 2024							
BY: AR							
Method of Shipment: FedEx				Sample Condition Upon Receipt:			
Relinquished by: Deborah A. Kasik		Date/Time: 4/17/24 2:30		Received by: AR		Date/Time: 4/19/24 09:35	
Relinquished by:		Date/Time:		Received by:		Date/Time:	

Controlled Document - Asbestos Bulk R7 9/14/2021

☐ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

FEDEX # 7968 3534 3242

Page 1 of 2



EMSL ANALYTICAL, INC.
LABORATORY PRODUCTS TRAINING

Asbestos Bulk Building Materials - Chain of Custody

EMSL Order Number / Lab Use Only

EMSL Analytical, Inc.
161 John Roberts Road

South Portland, ME 04106
PHONE: (207) 517-6921
EMAIL: portlandlab@emsl.com

622400336

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Nob per NDEP

Sample Number	HA Number	Sample Location	Material Description
CR-005A		Exterior Boiler Rm	Window Glazing
B		"	"
C		"	"
CR-006A		Men's Room	CT 4x2 fissure w/ pinhole
B		Hallway	"
C		Office	"
CR-007A		Hallway	Covebase adhesive
B		"	"
C		"	"
CR-008A		Hallway (near door to ext)	2" ft off white w/ brown flecks
B		File Storage	"
C		Lab	"
CR-009A		Hallway (near door to ext)	Black Mastic (ET)
B		File Storage	"
C		Lab	"
CR-010A		Office	Sheetrock
B		"	"
C		"	"
CR-011A		Hallway	Mudded pipe fitting
B		File Storage (near floor)	"
C		File Storage (above CT)	"
			RECEIVED
			APR 19 2024
		Please analyze CR-011ABC	BY: AR
		even if positive stop - thanks	
Method of Shipment	Fed Ex		Sample Condition Upon Receipt
Relinquished by: <u>SKASIK</u>	Date/Time: <u>4/18/24 2:30</u>	Received by: <u>AR</u>	Date/Time: <u>4/19/24 0930</u>
Relinquished by:	Date/Time:	Received by:	Date/Time:

Controlled Document - Asbestos Bulk R7 09/14/2021

☐ AGREE TO ELECTRONIC SIGNATURE (By checking I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.



APPENDIX D

LEAD-BASED PAINT/LEAD-CONTAINING SURFACE COATING DETERMINATION REPORT

ENVIRONMENTAL LEAD-BASED PAINT XRF RESULTS

		CLIENT:	DEPARTMENT OF AGRICULTURE 333 CONY ROAD, AUGUSTA, MAINE INTERIOR			DATE: HALEY WARD #: Page:	4/17/2024 10720.005 1	
XRF #		RMD LPA-1 #3305; ME Radiation License #31223			Inspector Signature:		Deborah A. Kasik/LR#0003	
FIELD ID #	SAMPLE LOCATION	SIDE	COMPONENT(S)	COLOR	SUBSTRATE TYPE:	RESULTS mg/cm ²	CONDITION	NOTES:
L-1	BOILER ROOM		ENTRY DOOR, CASING, JAMB	GRAY	METAL	0.5/0.0/0.2		
L-2			WALLS	LT. GRAY	CMU BLOCK	0.0		
L-3			CEILING	WHITE	PLASTER	0.1/0.0		
L-4			PIPING	WHITE	METAL	0.2		
L-5			WINDOW UNIT	SILVER	METAL	0.0		
L-6			MISC BOARD	WHITE	WOOD	0.7		NEAR WATER TREATMENT SYSTEM
L-7			HEADER ABOVE DOOR	GRAY	METAL	>9.9	FAIR/POOR	
L-8	MEN'S ROOM		PERIMETER - UPPER	YELLOW	CMU BLOCK	0.0/0.0		
L-9			PERIMETER - LOWER	DK. BLUE	CMU BLOCK	0.0/0.0		
L-10			INTERIOR UPPER WALLS	OFF WHITE	CMU BLOCK	0.0/0.4		
L-11			INTERIOR LOWER WALLS	CLEAR	CERAMIC TILE GLAZING	5.3/5.0	GOOD	
L-12			FLOOR	BROWN	CERAMIC	0.0/0.0		
L-13			ENTRY DOOR, CASING, JAMB	TAN	METAL	0.0/0.0		
L-14			ACCESS PANEL DOOR AND FRAME	TAN	METAL	0.0		
L-15			STRUCT. STEEL ABOVE CEILING	RED	METAL	0.5		
L-16	LADIES ROOM		HEATER	OFF WHITE	METAL	0.0		
L-17			INTERIOR LOWER WALLS	CLEAR	CERAMIC TILE GLAZING	5.4	GOOD	
L-18			ENTRY DOOR, CASING, JAMB	TAN	METAL	0.0/0.0		
P = Drywall; W = Plaster; W = Wood; M = Metal; C = Concrete; B = Brick; V = Vinyl; CER = Ceramic; O = Other (indicate material). Results expressed as mg/cm ² (milligrams per square centimeter)								

Drywall; P = Plaster; W = Wood; M = Metal; C = Concrete; B = Brick; V = Vinyl; CER = Ceramic; O = Other (indicate material). Results expressed as mg/cm² (milligrams per square centimeter)

		CLIENT: SITE: BLDG:	DEPARTMENT OF AGRICULTURE 333 CONY ROAD, AUGUSTA, MAINE INTERIOR			DATE: HALEY WARD #: Page:	4/17/2024 10720.005 2	
XRF #		RMD LPA-1 #3305; ME Radiation License #31223				Inspector Signature:		<i>Deborah A. Kasik/LR#0003</i>
FIELD ID #	SAMPLE LOCATION	SIDE	COMPONENT(S)	COLOR	SUBSTRATE TYPE:	RESULTS mg/cm²	CONDITION	NOTES:
L-19	JANITOR'S CLOSET		UPPER WALL	OFF WHITE	CMU BLOCK	0.0		
L-20			LOWER WALL	BROWN	CMU BLOCK	0.0/0.0		
L-21	HALLWAY		WALLS	PALE GREEN	CMU BLOCK	0.0/0.0		
L-22			DOORS, CASINGS, JAMBS	TAN	METAL	0.0/0.0/0.0		
L-23			DOOR TO EXTERIOR, CASING, JAMB	GRAY	METAL	0.0/0.0/0.0		
L-24			HEATER	OFF WHITE	METAL	0.0		
L-25			TRIM ON MOVEABLE WALLS	TAN	WOOD	0.2/0.0/0.0		
L-26			WALL TO RT OF DOOR	CLEAR	GLAZED BLOCK	5.0	GOOD	
L-27	LABORATORY		WALLS	CLEAR	GLAZED BLOCK	5.3	GOOD	
L-28			WINDOW UNITS	SILVER	METAL	0.0		
L-29			DOOR, CASING, JAMB	TAN	METAL	0.2/0.0/0.0		
L-30			HEATER	OFF WHITE	METAL	0.0		
L-31	LABORATORY CLOSET		CORRUGATED CEILING	GRAY	METAL	0.0		
L-32			PERIMETER INTERIOR WALLS	CLEAR	GLAZED BLOCK	5.3	GOOD	
L-33			DOOR, CASING, JAMB	GRAY	METAL	0.0/0.2/0.0		
L-34	FILE STORAGE		STRUCTURAL STEEL	RED	METAL	0.5		
L-35			WALLS	LT GREEN	CMU BLOCK	0.0/0.0		
L-36			DOOR FRAME	TAN	WOOD / METAL	0.0/0.0		
L-37			WINDOW UNITS	SILVER	METAL	0.0		
L-38			WINDOW SILLS	STAIN	WOOD	0.0/0.0		
D = Drywall; P = Plaster; W = Wood; M = Metal; C = Concrete; B = Brick; V = Vinyl; CER = Ceramic; O = Other (indicate material). Results expressed as mg/cm ² (milligrams per square centimeter)								

ENVIRONMENTAL LEAD-BASED PAINT XRF RESULTS

		CLIENT:	DEPARTMENT OF AGRICULTURE 333 CONY ROAD, AUGUSTA, MAINE			DATE:	4/17/2024	
		SITE:				HALEY WARD #:	10720.005	
		BLDG:	INTERIOR			Page:	3	
XRF #		RMD LPA-1 #3305; ME Radiation License #31223				Inspector Signature:		Deborah A. Kasik/LR#0003
FIELD ID #	SAMPLE LOCATION	SIDE	COMPONENT(S)	COLOR	SUBSTRATE TYPE:	RESULTS mg/cm ²	CONDITION	NOTES:
L-39	LABORATORY OFFICE		WALLS	CLEAR	GLAZED BLOCK	4.8	GOOD	
L-40			WINDOW SYSTEMS	SILVER	METAL	0.0		
L-41			HEATER	OFF WHITE	METAL	0.0		
L-42			DOOR FRAME	TAN	METAL	0.0/0.0		
L-43	OFFICE NO. 1		WALLS	OFF WHITE	CMU BLOCK	0.0/0.0		
L-44			HEATER	OFF WHITE	METAL	0.1		
L-45			DOOR , CASING, JAMB	TAN	METAL	0.2/0.0		
L-46			WINDOW SYSTEMS	SILVER	METAL	0.0		
L-47	OFFICE		WALLS	WHITE	DRYWALL	0.0/0.0		
L-48			DOOR FRAME	LT GRAY	METAL	0.0		
L-49			DOOR	STAIN	WOOD	0.0		
L-50			WALLS	OFF WHITE	CMU BLOCK	0.0		
L-51	MARKET'S DIVISION		DOOR AND FRAME	TAN	METAL	0.3/0.1		TO LAB AND FILE STORAGE
L-52			WALL AROUND DOOR	LT GREEN	CMU BLOCK	0.0		TO LAB AND FILE STORAGE
L-53	EXTERIOR		HALLWAY DOOR AND FRAME	GRAY	METAL	0.5/0.4		
L-54			DOOR HEADER	WHITE	METAL	1.6	POOR	
L-55			SIDING	RED	BRICK - NATURAL	0.0		
L-56			WINDOW HEADER	WHITE	METAL	1.0	POOR	ABOVE GLASS BLOCK WINDOW
L-57			WINDOW FRAMES	WHITE	METAL	0.0		
L-58			WINDOW HEADER	WHITE	METAL	0.9/1.4	GOOD	

HALEY WARD
ENGINEERING • ENVIRONMENTAL • CONSTRUCTION

BLDG:

Page:

4

Deborah A. Kasik/LR#0003

D = Drywall; P = Plaster; W = Wood; M = Metal; C = Concrete; B = Brick; V = Vinyl; CER = Ceramic; O = Other (indicate material). Results expressed as mg/cm² (milligrams per square centimeter)



APPENDIX E

PCB LABORATORY ANALYTICAL DATA



ANALYTICAL REPORT

Lab Number:	L2421497
Client:	Haley Ward, Inc 1 Merchants Plaza, #701 Bangor, ME 04401
ATTN:	Michael Sauda
Phone:	(207) 989-4824
Project Name:	ME DEPT OF AGRICULTURE
Project Number:	10720.005
Report Date:	04/26/24

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0826), IL (200077), IN (C-MA-03), KY (KY98045), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), OR (MA-1316), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #525-23-122-91930A1).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com



Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Lab Number: L2421497
Report Date: 04/26/24

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2421497-01	PCB-001A	SOLID	333 CONEY ROAD AUGUSTA, ME	04/17/24 09:30	04/18/24
L2421497-02	PCB-002A	SOLID	333 CONEY ROAD AUGUSTA, ME	04/17/24 09:40	04/18/24
L2421497-03	PCB-003A	SOLID	333 CONEY ROAD AUGUSTA, ME	04/17/24 09:45	04/18/24
L2421497-04	PCB-004A	SOLID	333 CONEY ROAD AUGUSTA, ME	04/17/24 12:50	04/18/24

Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Lab Number: L2421497
Report Date: 04/26/24

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

HOLD POLICY - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Lab Number: L2421497
Report Date: 04/26/24

Case Narrative (continued)

PCBs

L2421497-02D, -03D, and -04D: The sample has elevated detection limits due to limited sample volume available for analysis.

L2421497-02D, -03D, and -04D: The sample contains peaks which match the retention times for Aroclor 1254, but do not match the area ratios typical for this aroclor. The result for Aroclor 1254 is reported as "weathered".

L2421497-01D, -02D, -03D, and -04D: The surrogate recoveries are below the acceptance criteria for 2,4,5,6-tetrachloro-m-xylene (0%/0%) and decachlorobiphenyl (0%/0%) due to the dilution required to quantitate the sample. Re-extraction was not required; therefore, the results of the original analysis are reported.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:

Melissa Sturgis Melissa Sturgis

Title: Technical Director/Representative

Date: 04/26/24

QC OUTLIER SUMMARY REPORT

Project Name: ME DEPT OF AGRICULTURE

Lab Number: L2421497

Project Number: 10720.005

Report Date: 04/26/24

Method	Client ID (Native ID)	Lab ID	Parameter	QC Type	Recovery/RPD (%)	QC Limits (%)	Associated Samples	Data Quality Assessment
Polychlorinated Biphenyls by GC - Westborough Lab								
8082A	PCB-001A	L2421497-01 D	2,4,5,6-Tetrachloro-m-xylene (A)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-001A	L2421497-01 D	2,4,5,6-Tetrachloro-m-xylene (B)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-001A	L2421497-01 D	Decachlorobiphenyl (A)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-001A	L2421497-01 D	Decachlorobiphenyl (B)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-002A	L2421497-02 D	2,4,5,6-Tetrachloro-m-xylene (A)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-002A	L2421497-02 D	2,4,5,6-Tetrachloro-m-xylene (B)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-002A	L2421497-02 D	Decachlorobiphenyl (A)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-002A	L2421497-02 D	Decachlorobiphenyl (B)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-003A	L2421497-03 D	2,4,5,6-Tetrachloro-m-xylene (A)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-003A	L2421497-03 D	2,4,5,6-Tetrachloro-m-xylene (B)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-003A	L2421497-03 D	Decachlorobiphenyl (A)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-003A	L2421497-03 D	Decachlorobiphenyl (B)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-004A	L2421497-04 D	2,4,5,6-Tetrachloro-m-xylene (A)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-004A	L2421497-04 D	2,4,5,6-Tetrachloro-m-xylene (B)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-004A	L2421497-04 D	Decachlorobiphenyl (A)	Surrogate	0	30-150	-	-- not applicable --
8082A	PCB-004A	L2421497-04 D	Decachlorobiphenyl (B)	Surrogate	0	30-150	-	-- not applicable --

ORGANICS

PCBS

Project Name: ME DEPT OF AGRICULTURE**Lab Number:** L2421497**Project Number:** 10720.005**Report Date:** 04/26/24**SAMPLE RESULTS**

Lab ID: L2421497-01 D
 Client ID: PCB-001A
 Sample Location: 333 CONEY ROAD AUGUSTA, ME

Date Collected: 04/17/24 09:30
 Date Received: 04/18/24
 Field Prep: Not Specified

Sample Depth:

Matrix: Solid
 Analytical Method: 1,8082A
 Analytical Date: 04/25/24 17:21
 Analyst: RMP
 Percent Solids: Results reported on an 'AS RECEIVED' basis.

Extraction Method: EPA 3540C
 Extraction Date: 04/24/24 09:45
 Cleanup Method: EPA 3630
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3665A
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3660B
 Cleanup Date: 04/25/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	1230000	--	2000	A
Aroclor 1221	ND		ug/kg	1230000	--	2000	A
Aroclor 1232	ND		ug/kg	1230000	--	2000	A
Aroclor 1242	ND		ug/kg	617000	--	2000	A
Aroclor 1248	ND		ug/kg	1230000	--	2000	A
Aroclor 1254	63700000		ug/kg	1230000	--	2000	A
Aroclor 1260	ND		ug/kg	1230000	--	2000	A
Aroclor 1262	ND		ug/kg	1230000	--	2000	A
Aroclor 1268	ND		ug/kg	617000	--	2000	A
PCBs, Total	63700000		ug/kg	617000	--	2000	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	A
Decachlorobiphenyl	0	Q	30-150	A
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	B
Decachlorobiphenyl	0	Q	30-150	B

Project Name: ME DEPT OF AGRICULTURE**Lab Number:** L2421497**Project Number:** 10720.005**Report Date:** 04/26/24**SAMPLE RESULTS**

Lab ID: L2421497-02 D
 Client ID: PCB-002A
 Sample Location: 333 CONEY ROAD AUGUSTA, ME

Date Collected: 04/17/24 09:40
 Date Received: 04/18/24
 Field Prep: Not Specified

Sample Depth:

Matrix: Solid
 Analytical Method: 1,8082A
 Analytical Date: 04/25/24 17:55
 Analyst: RMP
 Percent Solids: Results reported on an 'AS RECEIVED' basis.

Extraction Method: EPA 3540C
 Extraction Date: 04/24/24 09:45
 Cleanup Method: EPA 3630
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3665A
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3660B
 Cleanup Date: 04/25/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	41200000	--	50000	A
Aroclor 1221	ND		ug/kg	41200000	--	50000	A
Aroclor 1232	ND		ug/kg	41200000	--	50000	A
Aroclor 1242	ND		ug/kg	20600000	--	50000	A
Aroclor 1248	ND		ug/kg	41200000	--	50000	A
Aroclor 1254	134000000		ug/kg	41200000	--	50000	A
Aroclor 1260	ND		ug/kg	41200000	--	50000	A
Aroclor 1262	ND		ug/kg	41200000	--	50000	A
Aroclor 1268	ND		ug/kg	20600000	--	50000	A
PCBs, Total	134000000		ug/kg	20600000	--	50000	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	A
Decachlorobiphenyl	0	Q	30-150	A
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	B
Decachlorobiphenyl	0	Q	30-150	B

Project Name: ME DEPT OF AGRICULTURE**Lab Number:** L2421497**Project Number:** 10720.005**Report Date:** 04/26/24**SAMPLE RESULTS**

Lab ID: L2421497-03 D
 Client ID: PCB-003A
 Sample Location: 333 CONEY ROAD AUGUSTA, ME

Date Collected: 04/17/24 09:45
 Date Received: 04/18/24
 Field Prep: Not Specified

Sample Depth:

Matrix: Solid
 Analytical Method: 1,8082A
 Analytical Date: 04/25/24 17:38
 Analyst: RMP
 Percent Solids: Results reported on an 'AS RECEIVED' basis.

Extraction Method: EPA 3540C
 Extraction Date: 04/24/24 09:45
 Cleanup Method: EPA 3630
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3665A
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3660B
 Cleanup Date: 04/25/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	1590000	--	2000	A
Aroclor 1221	ND		ug/kg	1590000	--	2000	A
Aroclor 1232	ND		ug/kg	1590000	--	2000	A
Aroclor 1242	ND		ug/kg	794000	--	2000	A
Aroclor 1248	ND		ug/kg	1590000	--	2000	A
Aroclor 1254	61500000		ug/kg	1590000	--	2000	B
Aroclor 1260	ND		ug/kg	1590000	--	2000	A
Aroclor 1262	ND		ug/kg	1590000	--	2000	A
Aroclor 1268	ND		ug/kg	794000	--	2000	A
PCBs, Total	61500000		ug/kg	794000	--	2000	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	A
Decachlorobiphenyl	0	Q	30-150	A
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	B
Decachlorobiphenyl	0	Q	30-150	B

Project Name: ME DEPT OF AGRICULTURE**Lab Number:** L2421497**Project Number:** 10720.005**Report Date:** 04/26/24**SAMPLE RESULTS**

Lab ID: L2421497-04 D
 Client ID: PCB-004A
 Sample Location: 333 CONEY ROAD AUGUSTA, ME

Date Collected: 04/17/24 12:50
 Date Received: 04/18/24
 Field Prep: Not Specified

Sample Depth:

Matrix: Solid
 Analytical Method: 1,8082A
 Analytical Date: 04/25/24 17:47
 Analyst: RMP
 Percent Solids: Results reported on an 'AS RECEIVED' basis.

Extraction Method: EPA 3540C
 Extraction Date: 04/24/24 09:45
 Cleanup Method: EPA 3630
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3665A
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3660B
 Cleanup Date: 04/25/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	4300000	--	2000	A
Aroclor 1221	ND		ug/kg	4300000	--	2000	A
Aroclor 1232	ND		ug/kg	4300000	--	2000	A
Aroclor 1242	ND		ug/kg	2150000	--	2000	A
Aroclor 1248	ND		ug/kg	4300000	--	2000	A
Aroclor 1254	131000000		ug/kg	4300000	--	2000	B
Aroclor 1260	ND		ug/kg	4300000	--	2000	A
Aroclor 1262	ND		ug/kg	4300000	--	2000	A
Aroclor 1268	ND		ug/kg	2150000	--	2000	A
PCBs, Total	131000000		ug/kg	2150000	--	2000	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	A
Decachlorobiphenyl	0	Q	30-150	A
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	B
Decachlorobiphenyl	0	Q	30-150	B

Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Lab Number: L2421497
Report Date: 04/26/24

Method Blank Analysis Batch Quality Control

Analytical Method: 1,8082A
 Analytical Date: 04/25/24 15:14
 Analyst: RMP

Extraction Method: EPA 3540C
 Extraction Date: 04/24/24 09:45
 Cleanup Method: EPA 3630
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3665A
 Cleanup Date: 04/25/24
 Cleanup Method: EPA 3660B
 Cleanup Date: 04/25/24

Parameter	Result	Qualifier	Units	RL	MDL	Column
Polychlorinated Biphenyls by GC - Westborough Lab for sample(s): 01-04 Batch: WG1912557-1						
Aroclor 1016	ND		ug/kg	512	--	A
Aroclor 1221	ND		ug/kg	512	--	A
Aroclor 1232	ND		ug/kg	512	--	A
Aroclor 1242	ND		ug/kg	256	--	A
Aroclor 1248	ND		ug/kg	512	--	A
Aroclor 1254	ND		ug/kg	512	--	A
Aroclor 1260	ND		ug/kg	512	--	A
Aroclor 1262	ND		ug/kg	512	--	A
Aroclor 1268	ND		ug/kg	256	--	A
PCBs, Total	ND		ug/kg	256	--	A

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	66		30-150	A
Decachlorobiphenyl	90		30-150	A
2,4,5,6-Tetrachloro-m-xylene	68		30-150	B
Decachlorobiphenyl	81		30-150	B

Lab Control Sample Analysis

Batch Quality Control

Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Lab Number: L2421497
Report Date: 04/26/24

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Polychlorinated Biphenyls by GC - Westborough Lab Associated sample(s): 01-04 Batch: WG1912557-2 WG1912557-3									
Aroclor 1016	74		76		40-140	3		50	A
Aroclor 1260	85		84		40-140	1		50	A

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	65		65		30-150	A
Decachlorobiphenyl	92		96		30-150	A
2,4,5,6-Tetrachloro-m-xylene	65		66		30-150	B
Decachlorobiphenyl	82		85		30-150	B

Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Serial_No:04262408:23
Lab Number: L2421497
Report Date: 04/26/24

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Present/Intact

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2421497-01A	Glass 60mL/2oz unpreserved	A	NA		2.4	Y	Present/Intact		PCB-8082-CAULK(365)
L2421497-02A	Glass 60mL/2oz unpreserved	A	NA		2.4	Y	Present/Intact		PCB-8082-CAULK(365)
L2421497-03A	Glass 60mL/2oz unpreserved	A	NA		2.4	Y	Present/Intact		PCB-8082-CAULK(365)
L2421497-04A	Glass 60mL/2oz unpreserved	A	NA		2.4	Y	Present/Intact		PCB-8082-CAULK(365)

Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Lab Number: L2421497
Report Date: 04/26/24

GLOSSARY

Acronyms

DL	- Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LOD	- Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
LOQ	- Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.) Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
NR	- No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: Data Usability Report



Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Lab Number: L2421497
Report Date: 04/26/24

Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA, this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

- A** - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).
- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- F** - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.
- G** - The concentration may be biased high due to matrix interferences (i.e. co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The lower value for the two columns has been reported due to obvious interference.
- J** - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

Report Format: Data Usability Report



Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Lab Number: L2421497
Report Date: 04/26/24

Data Qualifiers

- ND** - Not detected at the reporting limit (RL) for the sample.
- NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- R** - Analytical results are from sample re-analysis.
- RE** - Analytical results are from sample re-extraction.
- S** - Analytical results are from modified screening analysis.
- V** - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)
- Z** - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Project Name: ME DEPT OF AGRICULTURE
Project Number: 10720.005

Lab Number: L2421497
Report Date: 04/26/24

REFERENCES

- 1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - VI, 2018.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.



Alpha Analytical, Inc.

ID No.:17873

Facility: **Company-wide**

Revision 21

Department: **Quality Assurance**

Published Date: 04/17/2024

Title: **Certificate/Approval Program Summary**

Page 1 of 1

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility**EPA 624.1:** m/p-xylene, o-xylene, Naphthalene**EPA 625.1:** alpha-Terpineol**EPA 8260D:** NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.**EPA 8270E:** NPW: Dimethylnaphthalene, 1,4-Diphenylhydrazine, alpha-Terpineol, Azobenzene; SCM: Dimethylnaphthalene, 1,4-Diphenylhydrazine.**SM4500:** NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO₂, NO₃.**Mansfield Facility****SM 2540D:** TSS.**EPA TO-15:** Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene,

3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

Nonpotable Water: **EPA RSK-175 Dissolved Gases****Biological Tissue Matrix:** EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:**Drinking Water****EPA 300.0:** Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2:** Nitrate-N, Nitrite-N; **SM4500NO3-F:** Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE,****EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B****EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.**Microbiology:** **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, SM9222D.****Non-Potable Water****SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH:** Ammonia-N and Kjeldahl-N, **EPA 350.1:**Ammonia-N, **LACHAT 10-107-06-1-B:** Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2:** Nitrate-N, **SM4500P-E, SM4500P-B, E, SM4500SO4-E,****SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300:** Chloride, Sulfate, Nitrate.**EPA 624.1:** Volatile Halocarbons & Aromatics,**EPA 608.3:** Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II,

Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs

EPA 625.1: SVOC (Acid/Base/Neutral Extractables).**Microbiology:** **SM9223B-Colilert-QT; Enterolert-QT, EPA 1600, EPA 1603, SM9222D.****Mansfield Facility:****Drinking Water****EPA 200.7:** Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1 Hg.****EPA 522, EPA 537.1.****Non-Potable Water****EPA 200.7:** Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.**EPA 200.8:** Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.**EPA 245.1 Hg.****SM2340B**

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

Page 20 of 22

390 US Route One, #3
Falmouth, Maine 04105

FROM: Shipper Alpha	TO: Recipient Alpha
Street 72 Girden St	Street S. Main St
Origin Portland ME Zip Code 04112	Destination Lewiston ME Zip Code 04158
Phone #	Phone #

[illegible]

SHIPPER	PICK-UP TIME	RECIPIENT	DELIVERY TIME
COURIER SIGNATURE	DATE	COURIER SIGNATURE	DATE

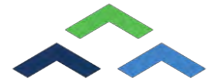
Page 21 of 22





APPENDIX F

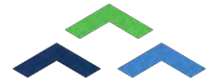
PHOTOGRAPHIC LOG



DEPARTMENT OF AGRICULTURE, CONSERVATION, AND FORESTRY
333 CONY ROAD, AUGUSTA, MAINE

Photo No. 1	
Photo Date: April 17, 2024	
Site Location: DACF Building 333 Cony Road Augusta, Maine	
Description: ACM mudded pipe fitting insulation on fiberglass-insulated line.	
Photo By: DAK	

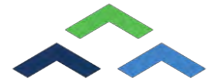
Photo No. 2	
Photo Date: April 17, 2024	
Site Location: DACF Building 333 Cony Road Augusta, Maine	
Description: ACM mudded pipe fitting insulation and tee insulation located above ceiling tiles.	
Photo By: DAK	



DEPARTMENT OF AGRICULTURE, CONSERVATION, AND FORESTRY
333 CONY ROAD, AUGUSTA, MAINE

Photo No. 3	
Photo Date: April 17, 2024	
Site Location: DACF Building 333 Cony Road Augusta, Maine	
Description: ACM (9x9) off-white with brown flecks floor tile and associated ACM black adhesive	
Photo By: DAK	

Photo No. 4	
Photo Date: April 17, 2024	
Site Location: DACF Building 333 Cony Road Augusta, Maine	
Description: ACM exterior window glazing around each pane of glass. PCB-containing caulk is located around window frame.	
Photo By: DAK	



DEPARTMENT OF AGRICULTURE, CONSERVATION, AND FORESTRY
333 CONY ROAD, AUGUSTA, MAINE

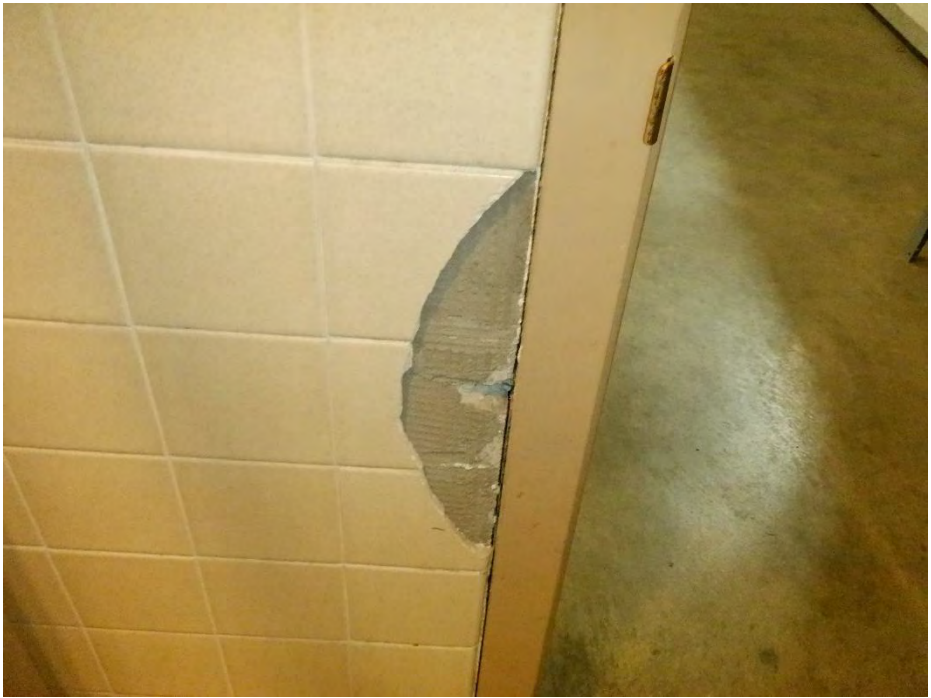
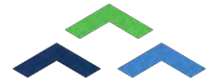
Photo No. 9	
Photo Date: April 17, 2024	
Site Location: DACF Building 333 Cony Road Augusta, Maine	
Description: Lead-based paint glazing on ceramic tile - lower portion of restroom walls	
Photo By: DAK	

Photo No. 10	
Photo Date: April 17, 2024	
Site Location: DACF Building 333 Cony Road Augusta, Maine	
Description: Lead-based paint glazing on block walls.	
Photo By: DAK	



DEPARTMENT OF AGRICULTURE, CONSERVATION, AND FORESTRY
333 CONY ROAD, AUGUSTA, MAINE

Photo No. 11	
Photo Date: April 17, 2024	
Site Location: DACF Building 333 Cony Road Augusta, Maine	
Description: PCB-containing gray door caulk.	
Photo By: DAK	

June 20, 2024

Ms. Celeste J. Poulin, MPA
Director, Division of Quality Assurance and Regulations
Department of Agriculture, Conservation & Forestry
State House Station 22 - 18 Elkins Lane
Augusta, Maine 04333
Email: celeste.poulin@maine.gov

**Re : Environmental Management Consulting Services | Supplemental Hazardous
Materials Assessment | 333 Cony Road | Augusta, Maine**

Dear Ms. Poulin:

At the request of Department of Agriculture, Conservation & Forestry (DACF), Haley Ward, Inc. (Haley Ward) completed a supplemental hazardous materials assessment (HMA) on June 7, 2024, to support the planned renovations of a portion of the facility located at 333 Cony Road in Augusta, Maine. The purpose of the supplemental HMA is to evaluate the impact of previously identified polychlorinated biphenyl (PCB) containing caulk, exceeding the U.S. Environmental Protection Agency (USEPA) threshold of greater than ($\geq$) 50.0 parts per million (ppm), on adjacent porous materials and adjacent soil. The identified PCB-containing caulk is associated with exterior window and door systems that will be impacted by a planned renovation.

BACKGROUND

PCBs were used as a plasticizer in caulk and in elastic sealant materials, primarily from 1950 through 1978. These caulks/sealants were commonly used in windows and associated window systems, door frames, stairways, masonry columns, and other masonry building materials.

On April 17, 2024, Haley Ward completed a Limited Hazardous Materials Assessment to identify and assess hazardous materials to support planned renovations to a portion of facility. Suspected PCB-containing caulk associated with exterior window and door units



in the affected areas of the building were identified with PCB concentrations ranging from 61,500 ppm to 134,000 ppm, exceeding the USEPA threshold of ≥ 50.0 ppm. At these concentrations, the PCB-containing caulk/sealant is not considered as an authorized use under the USEPA PCB regulations and must be removed. When removed, the caulk/sealant is considered a controlled hazardous waste material under the Toxic Substance Control Act (TSCA).

Porous masonry and soil adjoining or adjacent to PCB-containing caulk/sealant may become PCB-contaminated through migration or leaching of PCBs from the PCB-containing caulk/sealant. Haley Ward recommended the adjacent substrates and soil be assessed for the presence and concentration of PCBs to assist DACF in developing a scope of work for the removal adjacent or adjoining contaminated materials for incorporation into the planned renovation project.

On June 7, 2024, Ms. Deborah Kasik and Ms. Ivana Radovanovic (Haley Ward) completed an on-site assessment of the affected porous substrate and soil adjacent to identified PCB-containing caulk associated with the window and door systems to be impacted by the planned renovation.

PCB POROUS SUBSTRATE ASSESSMENT

Haley Ward collected representative samples of exterior masonry substrate (brick) adjacent to the PCB-containing caulk. The samples were collected using a rotary hammer drill with a steel bit which was advanced to a depth of at least 0.5 inch into the exterior brick in the vicinity of the identified PCB-containing caulk. Each collected sample was placed into laboratory provided containers. The drill bit was decontaminated before and after sampling at each sample location.

A total of nine representative samples were collected from three different locations of the affected masonry substrate. At each location, three separate samples were collected at varying distances from the PCB-containing caulk, where it contacts the porous substrate. Collected samples were submitted to Alpha Analytical (Alpha) of Westborough, Massachusetts, for laboratory analysis using USEPA Method SW-846-8082 and sample preparation USEPA Method SW-846 3540C (Soxhlet). Laboratory analytical results and chain of custody are included as **Attachment A**.

A summary of the laboratory analytical results is included in **TABLE 1**.



TABLE 1 | SUMMARY OF POROUS SUBSTRATE LABORATORY ANALYTICAL RESULTS
JUNE 7, 2024

SAMPLE #	TYPE/LOCATION	RESULT (PPM ¹)	COMMENTS
101A	Exterior Brick, South Elevation, Glass Block Window	16.900	Approximately two inches perpendicular from gray window frame caulk
101B	Exterior Brick, South Elevation, Glass Block Window	0.329	Approximately three inches horizontal from gray window frame caulk
101C	Exterior Brick, South Elevation, Glass Block Window	ND ²	Approximately seven inches horizontal from window frame caulk
102A	Exterior Brick, West Elevation, Conference Room Window	1.060	Approximately two inches perpendicular from gray window frame caulk
102B	Exterior Brick, West Elevation, Conference Room Window	0.182	Approximately three inches horizontal from gray window frame caulk
102C	Exterior Brick, West Elevation, Conference Room Window	ND ²	Approximately seven inches horizontal from window from gray window frame caulk
103A	Exterior Brick, North Elevation, Boiler Room Door	0.210	Approximately two inches perpendicular from gray door frame caulk
103B	Exterior Brick, North Elevation, Boiler Room Door	1.350	Approximately three inches horizontal from gray door frame caulk
103C	Exterior Brick, North Elevation, Boiler Room Door	ND ²	Approximately ten inches horizontal from gray door frame caulk

¹ PPM = Parts Per Million

² ND = Not Detected at reporting limit for the sample

PCB SOIL ASSESSMENT

Eight soil samples were collected, from the planned renovation area, at locations adjacent to or beneath window systems with identified PCB-containing caulk. Soil samples were collected from six inches and twelve inches from the building foundation. Two composite samples were collected at each sample location; one at a depth of six inches below ground surface (bgs) and one at a depth of twelve inches bgs.

The samples were analyzed by Alpha using modified USEPA Method SW-846-8082 and sample preparation Method SW-846 3540C (Soxhlet). Laboratory analytical results and chain of custody are included as **Attachment B**. A summary of the analytical results is included in **Table 2**.



TABLE 2 | SUMMARY OF SOIL LABORATORY ANALYTICAL RESULTS
JUNE 7, 2024

SOIL SAMPLE ID	LOCATION	DISTANCE FROM FOUNDATION (Linear feet)	SOIL DEPTH (Inches bgs ¹)	RESULTS (ppm ²)
201A	Beneath exterior glass block window (adjacent to door to hallway)	0.5	1-6	ND ³
201B		0.5	6-12	ND ³
201C		1	1-6	ND ³
201D		1	6-12	ND ³
202A	Beneath exterior window of conference room	0.5	1-6	0.432
202B		0.5	6-12	0.138
202C		1	1-6	0.101
202D		1	6-12	ND ³

¹ BGS = Below Ground Surface

² PPM = Parts Per Million

³ ND = Not Detected at reporting limit for the sample

A photographic log of typical sampled materials and sampling locations are included as **Attachment C**. A site plan identifying sample locations in **Figure H102** is included as **Attachment D**.

DISCUSSION/CONCLUSION

If the previously identified PCB-containing caulk associated with the windows and door systems within the affected area is to be disturbed during maintenance or repair activities or removed during the planned renovation, the removed materials containing the PCB-containing caulk should be handled and disposed of in accordance with Federal and State regulations and requirements. This may include compliance with TSCA, Maine Department of Environmental Protection (MDEP) Waste Regulations and Occupational Safety and Health Administration (OSHA) worker protection rules, as applicable.

Based on the results of this supplemental HMA and laboratory analysis of collected masonry samples, porous masonry located around the perimeter of affected window and door frames require proper removal and disposal as a regulated hazardous material.

Based on the laboratory analysis and assessment of the soil samples collected from beneath previously identified PCB-containing caulk, PCBs in the soil samples at concentrations over the threshold of 1.0 ppm were not identified. Based on this information, the soil does not require to be remediated and should be protected from



contamination during renovation and/or maintenance activities which disturb the identified PCB-containing caulk.

This report was prepared and reviewed by Haley Ward for the use of DACF and should not be reproduced without their full, written authorization. Haley Ward appreciates the opportunity to provide these environmental management consulting services to you. If you have any questions or need additional information, please feel free to contact either of the undersigned at (207) 989-4824.

Sincerely,
Haley Ward, Inc.

Michael D. Sauda, MPH, CSP
Senior Environmental Scientist

Dennis B. Kingman, Jr., CHMM
Vice President/Senior Project Manager II

MDS/DBK/kjf
Attachments



ATTACHMENT A

PCB POROUS SUBSTRATE LABORATORY ANALYTICAL RESULTS



ANALYTICAL REPORT

Lab Number:	L2432027
Client:	Haley Ward, Inc 1 Merchants Plaza, #701 Bangor, ME 04401
ATTN:	Michael Suda
Phone:	(207) 989-4824
Project Name:	DACF
Project Number:	10720.005-02
Report Date:	06/14/24

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0826), IL (200077), IN (C-MA-03), KY (KY98045), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), OR (MA-1316), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #525-23-122-91930A1).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2432027-01	101A	SOLID	AUGUSTA	06/07/24 10:52	06/07/24
L2432027-02	101B	SOLID	AUGUSTA	06/07/24 11:10	06/07/24
L2432027-03	101C	SOLID	AUGUSTA	06/07/24 11:24	06/07/24
L2432027-04	102A	SOLID	AUGUSTA	06/07/24 11:48	06/07/24
L2432027-05	102B	SOLID	AUGUSTA	06/07/24 12:00	06/07/24
L2432027-06	102C	SOLID	AUGUSTA	06/07/24 12:07	06/07/24
L2432027-07	103A	SOLID	AUGUSTA	06/07/24 12:25	06/07/24
L2432027-08	103B	SOLID	AUGUSTA	06/07/24 12:34	06/07/24
L2432027-09	103C	SOLID	AUGUSTA	06/07/24 12:45	06/07/24

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

HOLD POLICY - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

Case Narrative (continued)

PCBs

L2432027-01D, -02, -04, and -05: The sample contains peaks which match the retention times for Aroclor 1254, but do not match the area ratios typical for this aroclor. The result for Aroclor 1254 is reported as "weathered".

L2432027-01D: The surrogate recoveries are below the acceptance criteria for 2,4,5,6-tetrachloro-m-xylene (0%) and decachlorobiphenyl (0%) due to the dilution required to quantitate the sample. Re-extraction was not required; therefore, the results of the original analysis are reported.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:



Cristin Walker

Title: Technical Director/Representative

Date: 06/14/24

QC OUTLIER SUMMARY REPORT

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

Method	Client ID (Native ID)	Lab ID	Parameter	QC Type	Recovery/RPD (%)	QC Limits (%)	Associated Samples	Data Quality Assessment
Polychlorinated Biphenyls by GC - Westborough Lab								
8082A	101A	L2432027-01 D	2,4,5,6-Tetrachloro-m-xylene (A)	Surrogate	0	30-150	-	- - not applicable - -
8082A	101A	L2432027-01 D	2,4,5,6-Tetrachloro-m-xylene (B)	Surrogate	0	30-150	-	- - not applicable - -
8082A	101A	L2432027-01 D	Decachlorobiphenyl (A)	Surrogate	0	30-150	-	- - not applicable - -
8082A	101A	L2432027-01 D	Decachlorobiphenyl (B)	Surrogate	0	30-150	-	- - not applicable - -

ORGANICS

PCBS

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-01 D
Client ID: 101A
Sample Location: AUGUSTA

Date Collected: 06/07/24 10:52
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Solid
Analytical Method: 1,8082A
Analytical Date: 06/13/24 08:58
Analyst: MEO
Percent Solids: 100%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	1900	--	20	A
Aroclor 1221	ND		ug/kg	1900	--	20	A
Aroclor 1232	ND		ug/kg	1900	--	20	A
Aroclor 1242	ND		ug/kg	1900	--	20	A
Aroclor 1248	ND		ug/kg	1900	--	20	A
Aroclor 1254	16900		ug/kg	1900	--	20	A
Aroclor 1260	ND		ug/kg	1900	--	20	A
Aroclor 1262	ND		ug/kg	1900	--	20	A
Aroclor 1268	ND		ug/kg	1900	--	20	A
PCBs, Total	16900		ug/kg	1900	--	20	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	A
Decachlorobiphenyl	0	Q	30-150	A
2,4,5,6-Tetrachloro-m-xylene	0	Q	30-150	B
Decachlorobiphenyl	0	Q	30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-02
Client ID: 101B
Sample Location: AUGUSTA

Date Collected: 06/07/24 11:10
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Solid
Analytical Method: 1,8082A
Analytical Date: 06/13/24 04:47
Analyst: MEO
Percent Solids: 100%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	84.8	--	1	A
Aroclor 1221	ND		ug/kg	84.8	--	1	A
Aroclor 1232	ND		ug/kg	84.8	--	1	A
Aroclor 1242	ND		ug/kg	84.8	--	1	A
Aroclor 1248	ND		ug/kg	84.8	--	1	A
Aroclor 1254	329		ug/kg	84.8	--	1	B
Aroclor 1260	ND		ug/kg	84.8	--	1	A
Aroclor 1262	ND		ug/kg	84.8	--	1	A
Aroclor 1268	ND		ug/kg	84.8	--	1	A
PCBs, Total	329		ug/kg	84.8	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	82		30-150	A
Decachlorobiphenyl	70		30-150	A
2,4,5,6-Tetrachloro-m-xylene	76		30-150	B
Decachlorobiphenyl	61		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-03
Client ID: 101C
Sample Location: AUGUSTA

Date Collected: 06/07/24 11:24
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Solid
Analytical Method: 1,8082A
Analytical Date: 06/13/24 04:54
Analyst: MEO
Percent Solids: 99%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	98.6	--	1	A
Aroclor 1221	ND		ug/kg	98.6	--	1	A
Aroclor 1232	ND		ug/kg	98.6	--	1	A
Aroclor 1242	ND		ug/kg	98.6	--	1	A
Aroclor 1248	ND		ug/kg	98.6	--	1	A
Aroclor 1254	ND		ug/kg	98.6	--	1	B
Aroclor 1260	ND		ug/kg	98.6	--	1	A
Aroclor 1262	ND		ug/kg	98.6	--	1	A
Aroclor 1268	ND		ug/kg	98.6	--	1	A
PCBs, Total	ND		ug/kg	98.6	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	88		30-150	A
Decachlorobiphenyl	76		30-150	A
2,4,5,6-Tetrachloro-m-xylene	84		30-150	B
Decachlorobiphenyl	69		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-04
Client ID: 102A
Sample Location: AUGUSTA

Date Collected: 06/07/24 11:48
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Solid
Analytical Method: 1,8082A
Analytical Date: 06/13/24 05:32
Analyst: MEO
Percent Solids: 100%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	97.5	--	1	A
Aroclor 1221	ND		ug/kg	97.5	--	1	A
Aroclor 1232	ND		ug/kg	97.5	--	1	A
Aroclor 1242	ND		ug/kg	97.5	--	1	A
Aroclor 1248	ND		ug/kg	97.5	--	1	A
Aroclor 1254	1060		ug/kg	97.5	--	1	A
Aroclor 1260	ND		ug/kg	97.5	--	1	A
Aroclor 1262	ND		ug/kg	97.5	--	1	A
Aroclor 1268	ND		ug/kg	97.5	--	1	A
PCBs, Total	1060		ug/kg	97.5	--	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	97		30-150	A
Decachlorobiphenyl	87		30-150	A
2,4,5,6-Tetrachloro-m-xylene	92		30-150	B
Decachlorobiphenyl	79		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-05
Client ID: 102B
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:00
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Solid
Analytical Method: 1,8082A
Analytical Date: 06/13/24 05:40
Analyst: MEO
Percent Solids: 99%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	97.5	--	1	A
Aroclor 1221	ND		ug/kg	97.5	--	1	A
Aroclor 1232	ND		ug/kg	97.5	--	1	A
Aroclor 1242	ND		ug/kg	97.5	--	1	A
Aroclor 1248	ND		ug/kg	97.5	--	1	A
Aroclor 1254	182		ug/kg	97.5	--	1	B
Aroclor 1260	ND		ug/kg	97.5	--	1	A
Aroclor 1262	ND		ug/kg	97.5	--	1	A
Aroclor 1268	ND		ug/kg	97.5	--	1	A
PCBs, Total	182		ug/kg	97.5	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	93		30-150	A
Decachlorobiphenyl	89		30-150	A
2,4,5,6-Tetrachloro-m-xylene	85		30-150	B
Decachlorobiphenyl	76		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-06
Client ID: 102C
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:07
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Solid
Analytical Method: 1,8082A
Analytical Date: 06/13/24 05:47
Analyst: MEO
Percent Solids: 99%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	96.5	--	1	A
Aroclor 1221	ND		ug/kg	96.5	--	1	A
Aroclor 1232	ND		ug/kg	96.5	--	1	A
Aroclor 1242	ND		ug/kg	96.5	--	1	A
Aroclor 1248	ND		ug/kg	96.5	--	1	A
Aroclor 1254	ND		ug/kg	96.5	--	1	B
Aroclor 1260	ND		ug/kg	96.5	--	1	A
Aroclor 1262	ND		ug/kg	96.5	--	1	A
Aroclor 1268	ND		ug/kg	96.5	--	1	A
PCBs, Total	ND		ug/kg	96.5	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	94		30-150	A
Decachlorobiphenyl	90		30-150	A
2,4,5,6-Tetrachloro-m-xylene	89		30-150	B
Decachlorobiphenyl	80		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-07
Client ID: 103A
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:25
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Solid
Analytical Method: 1,8082A
Analytical Date: 06/13/24 05:55
Analyst: MEO
Percent Solids: 100%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	95.0	--	1	A
Aroclor 1221	ND		ug/kg	95.0	--	1	A
Aroclor 1232	ND		ug/kg	95.0	--	1	A
Aroclor 1242	ND		ug/kg	95.0	--	1	A
Aroclor 1248	ND		ug/kg	95.0	--	1	A
Aroclor 1254	210		ug/kg	95.0	--	1	B
Aroclor 1260	ND		ug/kg	95.0	--	1	A
Aroclor 1262	ND		ug/kg	95.0	--	1	A
Aroclor 1268	ND		ug/kg	95.0	--	1	A
PCBs, Total	210		ug/kg	95.0	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	86		30-150	A
Decachlorobiphenyl	78		30-150	A
2,4,5,6-Tetrachloro-m-xylene	80		30-150	B
Decachlorobiphenyl	71		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-08
Client ID: 103B
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:34
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Solid
Analytical Method: 1,8082A
Analytical Date: 06/13/24 06:02
Analyst: MEO
Percent Solids: 100%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	98.2	--	1	A
Aroclor 1221	ND		ug/kg	98.2	--	1	A
Aroclor 1232	ND		ug/kg	98.2	--	1	A
Aroclor 1242	ND		ug/kg	98.2	--	1	A
Aroclor 1248	ND		ug/kg	98.2	--	1	A
Aroclor 1254	1350		ug/kg	98.2	--	1	B
Aroclor 1260	ND		ug/kg	98.2	--	1	A
Aroclor 1262	ND		ug/kg	98.2	--	1	A
Aroclor 1268	ND		ug/kg	98.2	--	1	A
PCBs, Total	1350		ug/kg	98.2	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	86		30-150	A
Decachlorobiphenyl	80		30-150	A
2,4,5,6-Tetrachloro-m-xylene	82		30-150	B
Decachlorobiphenyl	74		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-09
Client ID: 103C
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:45
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Solid
Analytical Method: 1,8082A
Analytical Date: 06/13/24 06:10
Analyst: MEO
Percent Solids: 100%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	98.2	--	1	A
Aroclor 1221	ND		ug/kg	98.2	--	1	A
Aroclor 1232	ND		ug/kg	98.2	--	1	A
Aroclor 1242	ND		ug/kg	98.2	--	1	A
Aroclor 1248	ND		ug/kg	98.2	--	1	A
Aroclor 1254	ND		ug/kg	98.2	--	1	B
Aroclor 1260	ND		ug/kg	98.2	--	1	A
Aroclor 1262	ND		ug/kg	98.2	--	1	A
Aroclor 1268	ND		ug/kg	98.2	--	1	A
PCBs, Total	ND		ug/kg	98.2	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	85		30-150	A
Decachlorobiphenyl	82		30-150	A
2,4,5,6-Tetrachloro-m-xylene	82		30-150	B
Decachlorobiphenyl	78		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

Method Blank Analysis Batch Quality Control

Analytical Method: 1,8082A
Analytical Date: 06/13/24 05:02
Analyst: MHG

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 11:45
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Column
Polychlorinated Biphenyls by GC - Westborough Lab for sample(s): 01-09 Batch: WG1932648-1						
Aroclor 1016	ND		ug/kg	99.4	--	A
Aroclor 1221	ND		ug/kg	99.4	--	A
Aroclor 1232	ND		ug/kg	99.4	--	A
Aroclor 1242	ND		ug/kg	99.4	--	A
Aroclor 1248	ND		ug/kg	99.4	--	A
Aroclor 1254	ND		ug/kg	99.4	--	A
Aroclor 1260	ND		ug/kg	99.4	--	A
Aroclor 1262	ND		ug/kg	99.4	--	A
Aroclor 1268	ND		ug/kg	99.4	--	A
PCBs, Total	ND		ug/kg	99.4	--	A

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	75		30-150	A
Decachlorobiphenyl	64		30-150	A
2,4,5,6-Tetrachloro-m-xylene	71		30-150	B
Decachlorobiphenyl	59		30-150	B

Lab Control Sample Analysis

Batch Quality Control

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Polychlorinated Biphenyls by GC - Westborough Lab Associated sample(s): 01-09 Batch: WG1932648-2 WG1932648-3									
Aroclor 1016	88		88		40-140	0		50	A
Aroclor 1260	81		83		40-140	1		50	A

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	86		87		30-150	A
Decachlorobiphenyl	77		79		30-150	A
2,4,5,6-Tetrachloro-m-xylene	79		79		30-150	B
Decachlorobiphenyl	67		68		30-150	B

INORGANICS & MISCELLANEOUS

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-01
Client ID: 101A
Sample Location: AUGUSTA

Date Collected: 06/07/24 10:52
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Solid

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	99.5		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-02
Client ID: 101B
Sample Location: AUGUSTA

Date Collected: 06/07/24 11:10
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Solid

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	99.8		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-03
Client ID: 101C
Sample Location: AUGUSTA

Date Collected: 06/07/24 11:24
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Solid

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	99.4		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-04
Client ID: 102A
Sample Location: AUGUSTA

Date Collected: 06/07/24 11:48
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Solid

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	99.6		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-05
Client ID: 102B
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:00
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Solid

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	99.4		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-06
Client ID: 102C
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:07
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Solid

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	99.4		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-07
Client ID: 103A
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:25
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Solid

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	99.7		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-08
Client ID: 103B
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:34
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Solid

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	99.6		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432027-09
Client ID: 103C
Sample Location: AUGUSTA

Date Collected: 06/07/24 12:45
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Solid

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	100		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-09 Batch: WG1931675-2										
Solids, Total	99.8		%	0.100	NA	1	-	06/08/24 22:58	121,2540G	SJB

Project Name: DACF
Project Number: 10720.005-02

Serial_No:06142416:42
Lab Number: L2432027
Report Date: 06/14/24

Sample Receipt and Container Information

Were project specific reporting limits specified?

YES

Cooler Information

Cooler	Custody Seal
A	Present/Intact

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2432027-01A	Glass 60mL/2oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)
L2432027-02A	Glass 60mL/2oz unpreserved	A	NA		3.4	Y	Present/Intact		ME-TS-2540(7),PCB-8082-3540C(365)
L2432027-03A	Glass 60mL/2oz unpreserved	A	NA		3.4	Y	Present/Intact		ME-TS-2540(7),PCB-8082-3540C(365)
L2432027-04A	Glass 60mL/2oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)
L2432027-05A	Glass 60mL/2oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)
L2432027-06A	Glass 60mL/2oz unpreserved	A	NA		3.4	Y	Present/Intact		ME-TS-2540(7),PCB-8082-3540C(365)
L2432027-07A	Glass 60mL/2oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)
L2432027-08A	Glass 60mL/2oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)
L2432027-09A	Glass 60mL/2oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

GLOSSARY

Acronyms

DL	- Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LOD	- Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
LOQ	- Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.) Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
NR	- No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: Data Usability Report



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA, this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

- A** - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).
- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- F** - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.
- G** - The concentration may be biased high due to matrix interferences (i.e. co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The lower value for the two columns has been reported due to obvious interference.
- J** - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

Report Format: Data Usability Report



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

Data Qualifiers

- ND** - Not detected at the reporting limit (RL) for the sample.
- NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- R** - Analytical results are from sample re-analysis.
- RE** - Analytical results are from sample re-extraction.
- S** - Analytical results are from modified screening analysis.
- V** - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)
- Z** - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Project Name: DAF
Project Number: 10720.005-02

Lab Number: L2432027
Report Date: 06/14/24

REFERENCES

- 1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - VI, 2018.
- 121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.



Alpha Analytical, Inc.Facility: **Company-wide**Department: **Quality Assurance**Title: **Certificate/Approval Program Summary**ID No.: **17873**

Revision 21

Published Date: 04/17/2024

Page 1 of 1

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility**EPA 624.1:** m/p-xylene, o-xylene, Naphthalene**EPA 625.1:** alpha-Terpineol**EPA 8260D:** NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.**EPA 8270E:** NPW: Dimethylnaphthalene, 1,4-Diphenylhydrazine, alpha-Terpineol, Azobenzene; SCM: Dimethylnaphthalene, 1,4-Diphenylhydrazine.**SM4500:** NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO₂, NO₃.**Mansfield Facility****SM 2540D:** TSS.**EPA TO-15:** Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene,

3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

Nonpotable Water: **EPA RSK-175 Dissolved Gases****Biological Tissue Matrix:** EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:**Drinking Water****EPA 300.0:** Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2:** Nitrate-N, Nitrite-N; **SM4500NO3-F:** Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE,****EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B****EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.**Microbiology:** **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, SM9222D.****Non-Potable Water****SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH:** Ammonia-N and Kjeldahl-N, **EPA 350.1:**Ammonia-N, **LACHAT 10-107-06-1-B:** Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2:** Nitrate-N, **SM4500P-E, SM4500P-B, E, SM4500SO4-E,****SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300:** Chloride, Sulfate, Nitrate.**EPA 624.1:** Volatile Halocarbons & Aromatics,**EPA 608.3:** Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II,

Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs

EPA 625.1: SVOC (Acid/Base/Neutral Extractables).**Microbiology:** **SM9223B-Colilert-QT; Enterolert-QT, EPA 1600, EPA 1603, SM9222D.****Mansfield Facility:****Drinking Water****EPA 200.7:** Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.**EPA 522, EPA 537.1.****Non-Potable Water****EPA 200.7:** Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.**EPA 200.8:** Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.**EPA 245.1** Hg.**SM2340B**

For a complete listing of analytes and methods, please contact your Alpha Project Manager.



CHAIN OF CUSTODY

PAGE 1 OF 1

8 Walkup Drive
Westboro, MA 01581
Tel: 508-868-9220

320 Forbes Blvd
Mansfield, MA 02048
Tel: 508-822-9300

Project Information

Project Name: DACF
Project Location: Augusta
Project #: 10720-005-02
Project Manager:
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due:

Date Rec'd In Lab: 6/17/24ALPHA Job # 20432027

Report Information - Data Deliverables

☒ ADEx ☒ EMAIL

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements & Project Information Requirements

☐ Yes ☐ No MA MCP Analytical Methods ☐ Yes ☐ No CT RCP Analytical Methods
☐ Yes ☐ No Matrix Spikes Required on this SDG? (Required for MCP Inorganics)
☐ Yes ☐ No GW1 Standards (Info Required for Metals & EPH with Targets)
☐ Yes ☐ No NPDES RGP
☐ Other State /Fed. Program Criteria

Client Information

Client: Haley Ward
Address: 1 Merchant's Plaza
Bangor ME Ste 201
Phone: (207) 989-4824
Email: msauda@haleyward.com

Additional Project Information:

Soxhlet 8082DUST

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection		Sample Matrix	Sampler Initials	VOC:	SVOC:	METAL	METAL	EPH: L	VPH: L	✓PCB	TPH: L							Sample Comments	LES
		Date	Time																		
3002701	101A	6/7/24	10:52	X1	24/12							✓								Brick dust	
02	101B		11:10									✓									
03	101C		11:24									✓									
04	102A		11:48									✓									
05	102B		12:00									✓									
06	102C		12:07									✓									
07	103A		12:25									✓									
08	103B		12:34									✓									
09	103C	✓	12:45									✓									

Container Type

P= Plastic
A= Amber glass
V= Vial
G= Glass
B= Bacteria cup
C= Cube
O= Other
E= Encore
D= BOD Bottle

Preservative

A= None
B= HCl
C= HNO₃
D= H₂SO₄
E= NaOH
F= NaOH
G= NaHSO₄
H= Na₂S₂O₈
I= Ascorbic Acid
J= NH₄Cl
K= Zn Acetate
O= Other

Container Type

Preservative

A
Ice

Relinquished By:

Deborah Glasik
Deborah Glasik

Date/Time

6/7/24 1435
6/12/24 1600

Received By:

Paula
Deborah Glasik
Deborah Glasik

Date/Time

6/24 1435
6/12/24 1600
6/12/24 1600

All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 12-Mar-2012)

6/7/24 23:25

390 US Route One, #3
Falmouth, Maine 04105

RECIPIENT COPY





ATTACHMENT B

PCB SOIL LABORATORY ANALYTICAL RESULTS



ANALYTICAL REPORT

Lab Number:	L2432019
Client:	Haley Ward, Inc 1 Merchants Plaza, #701 Bangor, ME 04401
ATTN:	Michael Sauda
Phone:	(207) 989-4824
Project Name:	DACF
Project Number:	10720.005-02
Report Date:	06/14/24

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), CT (PH-0826), IL (200077), IN (C-MA-03), KY (KY98045), ME (MA00086), MD (348), NJ (MA935), NY (11148), NC (25700/666), OR (MA-1316), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #525-23-122-91930A1).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2432019-01	201A	SOIL	AUGUSTA	06/07/24 09:03	06/07/24
L2432019-02	201B	SOIL	AUGUSTA	06/07/24 09:07	06/07/24
L2432019-03	201C	SOIL	AUGUSTA	06/07/24 09:13	06/07/24
L2432019-04	201D	SOIL	AUGUSTA	06/07/24 09:16	06/07/24
L2432019-05	202A	SOIL	AUGUSTA	06/07/24 09:25	06/07/24
L2432019-06	202B	SOIL	AUGUSTA	06/07/24 09:44	06/07/24
L2432019-07	202C	SOIL	AUGUSTA	06/07/24 09:51	06/07/24
L2432019-08	202D	SOIL	AUGUSTA	06/07/24 10:00	06/07/24

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

HOLD POLICY - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:

 Cristin Walker

Title: Technical Director/Representative

Date: 06/14/24

QC OUTLIER SUMMARY REPORT

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

Method	Client ID (Native ID)	Lab ID	Parameter	QC Type	Recovery/RPD (%)	QC Limits (%)	Associated Samples	Data Quality Assessment

There are no QC Outliers associated with this report.

ORGANICS

PCBS

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-01
Client ID: 201A
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:03
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Soil
Analytical Method: 1,8082A
Analytical Date: 06/13/24 02:31
Analyst: MEO
Percent Solids: 95%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 12:10
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	49.2	--	1	A
Aroclor 1221	ND		ug/kg	49.2	--	1	A
Aroclor 1232	ND		ug/kg	49.2	--	1	A
Aroclor 1242	ND		ug/kg	49.2	--	1	A
Aroclor 1248	ND		ug/kg	49.2	--	1	A
Aroclor 1254	ND		ug/kg	49.2	--	1	B
Aroclor 1260	ND		ug/kg	49.2	--	1	A
Aroclor 1262	ND		ug/kg	49.2	--	1	A
Aroclor 1268	ND		ug/kg	49.2	--	1	A
PCBs, Total	ND		ug/kg	49.2	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	92		30-150	A
Decachlorobiphenyl	79		30-150	A
2,4,5,6-Tetrachloro-m-xylene	88		30-150	B
Decachlorobiphenyl	73		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-02
Client ID: 201B
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:07
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Soil
Analytical Method: 1,8082A
Analytical Date: 06/13/24 02:39
Analyst: MEO
Percent Solids: 94%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 12:10
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	48.7	--	1	A
Aroclor 1221	ND		ug/kg	48.7	--	1	A
Aroclor 1232	ND		ug/kg	48.7	--	1	A
Aroclor 1242	ND		ug/kg	48.7	--	1	A
Aroclor 1248	ND		ug/kg	48.7	--	1	A
Aroclor 1254	ND		ug/kg	48.7	--	1	B
Aroclor 1260	ND		ug/kg	48.7	--	1	A
Aroclor 1262	ND		ug/kg	48.7	--	1	A
Aroclor 1268	ND		ug/kg	48.7	--	1	A
PCBs, Total	ND		ug/kg	48.7	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	88		30-150	A
Decachlorobiphenyl	75		30-150	A
2,4,5,6-Tetrachloro-m-xylene	85		30-150	B
Decachlorobiphenyl	72		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-03
Client ID: 201C
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:13
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Soil
Analytical Method: 1,8082A
Analytical Date: 06/13/24 02:46
Analyst: MEO
Percent Solids: 93%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 12:10
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	49.9	--	1	A
Aroclor 1221	ND		ug/kg	49.9	--	1	A
Aroclor 1232	ND		ug/kg	49.9	--	1	A
Aroclor 1242	ND		ug/kg	49.9	--	1	A
Aroclor 1248	ND		ug/kg	49.9	--	1	A
Aroclor 1254	ND		ug/kg	49.9	--	1	B
Aroclor 1260	ND		ug/kg	49.9	--	1	A
Aroclor 1262	ND		ug/kg	49.9	--	1	A
Aroclor 1268	ND		ug/kg	49.9	--	1	A
PCBs, Total	ND		ug/kg	49.9	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	90		30-150	A
Decachlorobiphenyl	75		30-150	A
2,4,5,6-Tetrachloro-m-xylene	83		30-150	B
Decachlorobiphenyl	71		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-04
Client ID: 201D
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:16
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Soil
Analytical Method: 1,8082A
Analytical Date: 06/13/24 02:54
Analyst: MEO
Percent Solids: 93%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 12:10
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	49.7	--	1	A
Aroclor 1221	ND		ug/kg	49.7	--	1	A
Aroclor 1232	ND		ug/kg	49.7	--	1	A
Aroclor 1242	ND		ug/kg	49.7	--	1	A
Aroclor 1248	ND		ug/kg	49.7	--	1	A
Aroclor 1254	ND		ug/kg	49.7	--	1	B
Aroclor 1260	ND		ug/kg	49.7	--	1	A
Aroclor 1262	ND		ug/kg	49.7	--	1	A
Aroclor 1268	ND		ug/kg	49.7	--	1	A
PCBs, Total	ND		ug/kg	49.7	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	85		30-150	A
Decachlorobiphenyl	74		30-150	A
2,4,5,6-Tetrachloro-m-xylene	81		30-150	B
Decachlorobiphenyl	70		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-05
Client ID: 202A
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:25
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Soil
Analytical Method: 1,8082A
Analytical Date: 06/13/24 03:01
Analyst: MEO
Percent Solids: 81%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 12:10
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	58.3	--	1	A
Aroclor 1221	ND		ug/kg	58.3	--	1	A
Aroclor 1232	ND		ug/kg	58.3	--	1	A
Aroclor 1242	ND		ug/kg	58.3	--	1	A
Aroclor 1248	ND		ug/kg	58.3	--	1	A
Aroclor 1254	432		ug/kg	58.3	--	1	A
Aroclor 1260	ND		ug/kg	58.3	--	1	A
Aroclor 1262	ND		ug/kg	58.3	--	1	A
Aroclor 1268	ND		ug/kg	58.3	--	1	A
PCBs, Total	432		ug/kg	58.3	--	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	96		30-150	A
Decachlorobiphenyl	83		30-150	A
2,4,5,6-Tetrachloro-m-xylene	82		30-150	B
Decachlorobiphenyl	69		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-06
Client ID: 202B
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:44
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Soil
Analytical Method: 1,8082A
Analytical Date: 06/13/24 03:09
Analyst: MEO
Percent Solids: 83%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 12:10
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	56.0	--	1	A
Aroclor 1221	ND		ug/kg	56.0	--	1	A
Aroclor 1232	ND		ug/kg	56.0	--	1	A
Aroclor 1242	ND		ug/kg	56.0	--	1	A
Aroclor 1248	ND		ug/kg	56.0	--	1	A
Aroclor 1254	138		ug/kg	56.0	--	1	A
Aroclor 1260	ND		ug/kg	56.0	--	1	A
Aroclor 1262	ND		ug/kg	56.0	--	1	A
Aroclor 1268	ND		ug/kg	56.0	--	1	A
PCBs, Total	138		ug/kg	56.0	--	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	101		30-150	A
Decachlorobiphenyl	88		30-150	A
2,4,5,6-Tetrachloro-m-xylene	82		30-150	B
Decachlorobiphenyl	71		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-07
Client ID: 202C
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:51
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Soil
Analytical Method: 1,8082A
Analytical Date: 06/13/24 03:16
Analyst: MEO
Percent Solids: 80%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 12:10
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	59.7	--	1	A
Aroclor 1221	ND		ug/kg	59.7	--	1	A
Aroclor 1232	ND		ug/kg	59.7	--	1	A
Aroclor 1242	ND		ug/kg	59.7	--	1	A
Aroclor 1248	ND		ug/kg	59.7	--	1	A
Aroclor 1254	101		ug/kg	59.7	--	1	B
Aroclor 1260	ND		ug/kg	59.7	--	1	A
Aroclor 1262	ND		ug/kg	59.7	--	1	A
Aroclor 1268	ND		ug/kg	59.7	--	1	A
PCBs, Total	101		ug/kg	59.7	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	86		30-150	A
Decachlorobiphenyl	73		30-150	A
2,4,5,6-Tetrachloro-m-xylene	84		30-150	B
Decachlorobiphenyl	73		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-08
Client ID: 202D
Sample Location: AUGUSTA

Date Collected: 06/07/24 10:00
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:

Matrix: Soil
Analytical Method: 1,8082A
Analytical Date: 06/13/24 03:24
Analyst: MEO
Percent Solids: 81%

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 12:10
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	59.5	--	1	A
Aroclor 1221	ND		ug/kg	59.5	--	1	A
Aroclor 1232	ND		ug/kg	59.5	--	1	A
Aroclor 1242	ND		ug/kg	59.5	--	1	A
Aroclor 1248	ND		ug/kg	59.5	--	1	A
Aroclor 1254	ND		ug/kg	59.5	--	1	B
Aroclor 1260	ND		ug/kg	59.5	--	1	A
Aroclor 1262	ND		ug/kg	59.5	--	1	A
Aroclor 1268	ND		ug/kg	59.5	--	1	A
PCBs, Total	ND		ug/kg	59.5	--	1	B

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	82		30-150	A
Decachlorobiphenyl	69		30-150	A
2,4,5,6-Tetrachloro-m-xylene	79		30-150	B
Decachlorobiphenyl	69		30-150	B

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

Method Blank Analysis Batch Quality Control

Analytical Method: 1,8082A
Analytical Date: 06/13/24 02:08
Analyst: MEO

Extraction Method: EPA 3540C
Extraction Date: 06/11/24 12:10
Cleanup Method: EPA 3665A
Cleanup Date: 06/12/24
Cleanup Method: EPA 3660B
Cleanup Date: 06/13/24

Parameter	Result	Qualifier	Units	RL	MDL	Column
Polychlorinated Biphenyls by GC - Westborough Lab for sample(s): 01-08 Batch: WG1932677-1						
Aroclor 1016	ND		ug/kg	46.9	--	A
Aroclor 1221	ND		ug/kg	46.9	--	A
Aroclor 1232	ND		ug/kg	46.9	--	A
Aroclor 1242	ND		ug/kg	46.9	--	A
Aroclor 1248	ND		ug/kg	46.9	--	A
Aroclor 1254	ND		ug/kg	46.9	--	A
Aroclor 1260	ND		ug/kg	46.9	--	A
Aroclor 1262	ND		ug/kg	46.9	--	A
Aroclor 1268	ND		ug/kg	46.9	--	A
PCBs, Total	ND		ug/kg	46.9	--	A

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	93		30-150	A
Decachlorobiphenyl	73		30-150	A
2,4,5,6-Tetrachloro-m-xylene	85		30-150	B
Decachlorobiphenyl	70		30-150	B

Lab Control Sample Analysis Batch Quality Control

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Polychlorinated Biphenyls by GC - Westborough Lab Associated sample(s): 01-08 Batch: WG1932677-2 WG1932677-3									
Aroclor 1016	94		98		40-140	4		50	A
Aroclor 1260	81		90		40-140	11		50	A

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	90		97		30-150	A
Decachlorobiphenyl	73		85		30-150	A
2,4,5,6-Tetrachloro-m-xylene	85		90		30-150	B
Decachlorobiphenyl	68		75		30-150	B

INORGANICS & MISCELLANEOUS

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-01
Client ID: 201A
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:03
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	94.9		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-02
Client ID: 201B
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:07
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	93.8		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-03
Client ID: 201C
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:13
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	92.8		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-04
Client ID: 201D
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:16
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	93.1		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-05
Client ID: 202A
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:25
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	81.2		%	0.100	NA	1	-	06/11/24 02:12	121,2540G	ODJ



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-06
Client ID: 202B
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:44
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	83.0		%	0.100	NA	1	-	06/11/24 02:12	121,2540G	ODJ



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-07
Client ID: 202C
Sample Location: AUGUSTA

Date Collected: 06/07/24 09:51
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	79.8		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

SAMPLE RESULTS

Lab ID: L2432019-08
Client ID: 202D
Sample Location: AUGUSTA

Date Collected: 06/07/24 10:00
Date Received: 06/07/24
Field Prep: Not Specified

Sample Depth:
Matrix: Soil

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	80.6		%	0.100	NA	1	-	06/08/24 22:46	121,2540G	SJB



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab for sample(s): 01-04,07-08 Batch: WG1931675-2										
Solids, Total	99.8		%	0.100	NA	1	-	06/08/24 22:58	121,2540G	SJB
General Chemistry - Westborough Lab for sample(s): 05-06 Batch: WG1932368-2										
Solids, Total	100		%	0.100	NA	1	-	06/11/24 02:12	121,2540G	ODJ



Lab Duplicate Analysis

Batch Quality Control

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-04,07-08 QC Batch ID: WG1931675-1 QC Sample: L2432019-01 Client ID: 201A						
Solids, Total	94.9	95.0	%	0		20
General Chemistry - Westborough Lab Associated sample(s): 05-06 QC Batch ID: WG1932368-1 QC Sample: L2432019-05 Client ID: 202A						
Solids, Total	81.2	80.8	%	0		20

Project Name: DACF
Project Number: 10720.005-02

Serial_No:06142416:20
Lab Number: L2432019
Report Date: 06/14/24

Sample Receipt and Container Information

Were project specific reporting limits specified?

YES

Cooler Information

Cooler	Custody Seal
A	Present/Intact

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2432019-01A	Glass 250ml/8oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)
L2432019-02A	Glass 250ml/8oz unpreserved	A	NA		3.4	Y	Present/Intact		ME-TS-2540(7),PCB-8082-3540C(365)
L2432019-03A	Glass 250ml/8oz unpreserved	A	NA		3.4	Y	Present/Intact		ME-TS-2540(7),PCB-8082-3540C(365)
L2432019-04A	Glass 250ml/8oz unpreserved	A	NA		3.4	Y	Present/Intact		ME-TS-2540(7),PCB-8082-3540C(365)
L2432019-05A	Glass 250ml/8oz unpreserved	A	NA		3.4	Y	Present/Intact		ME-TS-2540(7),PCB-8082-3540C(365)
L2432019-06A	Glass 250ml/8oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)
L2432019-07A	Glass 250ml/8oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)
L2432019-08A	Glass 250ml/8oz unpreserved	A	NA		3.4	Y	Present/Intact		PCB-8082-3540C(365),ME-TS-2540(7)

Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

GLOSSARY

Acronyms

DL	- Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LOD	- Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
LOQ	- Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
	Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
NR	- No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: Data Usability Report



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA, this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

- A** - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).
- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- F** - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.
- G** - The concentration may be biased high due to matrix interferences (i.e. co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The lower value for the two columns has been reported due to obvious interference.
- J** - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

Report Format: Data Usability Report



Project Name: DACF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

Data Qualifiers

- ND** - Not detected at the reporting limit (RL) for the sample.
- NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- R** - Analytical results are from sample re-analysis.
- RE** - Analytical results are from sample re-extraction.
- S** - Analytical results are from modified screening analysis.
- V** - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)
- Z** - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Project Name: DAF
Project Number: 10720.005-02

Lab Number: L2432019
Report Date: 06/14/24

REFERENCES

- 1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - VI, 2018.
- 121 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WEF. Standard Methods Online.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.



Alpha Analytical, Inc.Facility: **Company-wide**Department: **Quality Assurance**Title: **Certificate/Approval Program Summary**ID No.: **17873**

Revision 21

Published Date: 04/17/2024

Page 1 of 1

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility**EPA 624.1:** m/p-xylene, o-xylene, Naphthalene**EPA 625.1:** alpha-Terpineol**EPA 8260D:** NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.**EPA 8270E:** NPW: Dimethylnaphthalene, 1,4-Diphenylhydrazine, alpha-Terpineol, Azobenzene; SCM: Dimethylnaphthalene, 1,4-Diphenylhydrazine.**SM4500:** NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO₂, NO₃.**Mansfield Facility****SM 2540D:** TSS.**EPA TO-15:** Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene,

3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

Nonpotable Water: **EPA RSK-175 Dissolved Gases****Biological Tissue Matrix:** EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:**Drinking Water****EPA 300.0:** Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2:** Nitrate-N, Nitrite-N; **SM4500NO3-F:** Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE,****EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B****EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.**Microbiology:** **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, SM9222D.****Non-Potable Water****SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH:** Ammonia-N and Kjeldahl-N, **EPA 350.1:**Ammonia-N, **LACHAT 10-107-06-1-B:** Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2:** Nitrate-N, **SM4500P-E, SM4500P-B, E, SM4500SO4-E,****SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300:** Chloride, Sulfate, Nitrate.**EPA 624.1:** Volatile Halocarbons & Aromatics,**EPA 608.3:** Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II,

Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs

EPA 625.1: SVOC (Acid/Base/Neutral Extractables).**Microbiology:** **SM9223B-Colilert-QT; Enterolert-QT, EPA 1600, EPA 1603, SM9222D.****Mansfield Facility:****Drinking Water****EPA 200.7:** Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.**EPA 522, EPA 537.1.****Non-Potable Water****EPA 200.7:** Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.**EPA 200.8:** Al, Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.**EPA 245.1** Hg.**SM2340B**

For a complete listing of analytes and methods, please contact your Alpha Project Manager.



8 Wakeup Drive
Westboro, MA 01581
Tel: 508-898-9220

320 Forbes Blvd.
Mansfield, MA 02048
Tel: 508-822-9300

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab: 6/7/24

ALPHA Job #: 33019

Project Information

Project Name: DACC

Project Location: Augusta

Project #: 10720.005-02

Project Manager:

ALPHA Quote #:

Turn-Around Time

Standard

☐ RUSH (only confirmed if pre-approved)

Date Due:

Report Information - Data Deliverables

☒ ADEX

☒ EMAIL

☐ Same as Client info

PO #:

Regulatory Requirements & Project Information Requirements

☐ Yes ☐ No MA MCP Analytical Methods

☐ Yes ☐ No CT RCP Analytical Methods

☐ Yes ☐ No Matrix Spike Required on this SDG? (Required for MCP Inorganics)

☐ Yes ☐ No GW1 Standards (Info Required for Metals & EPH with Targets)

☐ Yes ☐ No NPDES RGP

☐ Other State /Fed Program Criteria

Client Information

Client: Haley Ward

Address: 1 Merchants Glen

Bangor ME STE 701

Phone: (207) 989-4824

Email: msanda@haleyward.com

Additional Project Information:

Soxhlet 8082

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection		Sample Matrix	Sampler Initials	VOC:	SVOC:	METAL	METAL	EPH: C	VPH: C	E PCB	TPH: C																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

Container Type

P= Plastic
A= Amber glass
V= Vial
G= Glass
B= Bacteria cup
C= Cube
O= Other
E= Encore
D= BOD Bottle

Preservative

A= None
B= HCl
C= HNO₃
D= H₂SO₄
E= NaOH
F= MeOH
G= NaHSO₄
H= Na₂S₂O₅
I= Ascorbic Acid
J= NH₄Cl
K= Zn Acetate
O= Other

Container Type

Preservative

A

ice

Relinquished By:

Date/Time

Received By:

Date/Time

Deborah J. Kasik
Haley Ward
6/7/24 14:35
6/7/24 16:41
6/7/24 18:00

6/7/24 14:35

Race
Haley Ward
6/7/24 16:41

6/7/24 18:00

All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 12-Mar-2012)

6/7/24 23:25

117601

390 US Route One, #3
Falmouth, Maine 04105

No. Pieces	Weight Each	Description of Items	Total Weight (Subject to Correction)	Oversize Charge	Shipping Charges
3		Coat			
4					

Please use complete ship to address.
Uniship can not deliver to P.O. Boxes.

Shipper hereby certifies that he is familiar with all the bill of lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

DATE _____

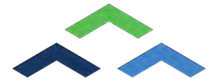
RECIPIENT COPY





ATTACHMENT C

PHOTOGRAPHIC LOG



MAINE DEPARTMENT OF AGRICULTURE
SUPPLEMENTAL PCB SAMPLING

Photo No. 1	
Photo Date: June 7, 2024	
Site Location: 333 Cony Road, Augusta, Maine	
Description: South Elevation; General location of samples 101A, B, and C (masonry) and samples 201A, B, C, and D (soil).	
Photo By: IR	

Photo No. 2	
Photo Date: June 7, 2024	
Site Location: 333 Cony Road, Augusta, Maine	
Description: South Elevation; General location of samples 101A, B, and C (masonry)	
Photo By: IR	



MAINE DEPARTMENT OF AGRICULTURE
SUPPLEMENTAL PCB SAMPLING

Photo No. 3	
Photo Date: June 7, 2024	
Site Location: 333 Cony Road, Augusta, Maine	
Description: South Elevation: General location of samples 201 A and B.	
Photo By: IR	

Photo No. 4	
Photo Date: June 7, 2024	
Site Location: 333 Cony Road, Augusta, Maine	
Description: South Elevation: General locations of samples 201 C, and 201 D.	
Photo By: IR	



MAINE DEPARTMENT OF AGRICULTURE
SUPPLEMENTAL PCB SAMPLING

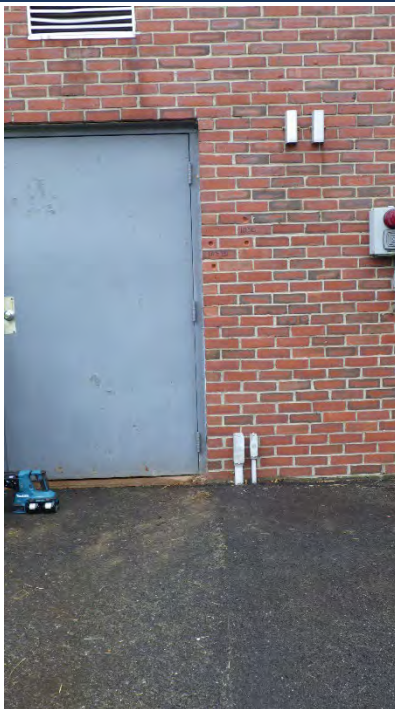
Photo No. 5	
Photo Date: June 7, 2024	
Site Location: 333 Cony Road, Augusta, Maine	
Description: West Elevation: General location of samples 102 A, B, and C (masonry) and 202 A, B, C, and D (soil).	
Photo By: IR	

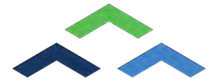
Photo No. 6	
Photo Date: June 7, 2024	
Site Location: 333 Cony Road, Augusta, Maine	
Description: West Elevation: Locations of samples 102 A, B, and C.	
Photo By: IR	



MAINE DEPARTMENT OF AGRICULTURE
SUPPLEMENTAL PCB SAMPLING

Photo No. 7	
Photo Date: June 7, 2024	
Site Location: 333 Cony Road, Augusta, Maine	
Description: West Elevation: Locations of samples 202A,B, C, and D.	
Photo By: IR	

Photo No. 8	
Photo Date: June 7, 2024	
Site Location: 333 Cony Road, Augusta, Maine	
Description: North Elevation: General location of samples 103A,B, and C (masonry).	
Photo By: IR	



MAINE DEPARTMENT OF AGRICULTURE
SUPPLEMENTAL PCB SAMPLING

Photo No. 9	
Photo Date: June 7, 2024	
Site Location: 333 Cony Road, Augusta, Maine	
Description: North Elevation: Locations of samples 103A,B, and C.	
Photo By: IR	



ATTACHMENT D

FIGURE H102 -SAMPLING LOCATIONS

FILE LOCATION: P:\ME\10720-MAINE_DEPT_OF_AGRICULTURE\005-333 CONY ROAD HAZARDOUS MATERIALS ASSESSMENT - 03KGS.CAD; J:\LISEN\PERMANENTAL\10720.005 DEPT. OF AGRICULTURE - 1001.DWG, 2024.06.20, 8:08 AM



SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 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.

1.4 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: A Part 3 "Schedule of Alternates" Article is 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

A. Bid Alternate No. 1: Thermal Upgrades.

1. Provide specified wall type on west and north walls of Storage 116 and on north and east walls of future Training Space 119.

B. Bid Alternate No. 2: Insulation Material.

1. Substitute dense-pack cellulose fiber insulation for dens-pack wood fiber insulation.

C. Bid Alternate No. 3: Generator Upgrade.

1. Convert existing generator to a natural gas-fired generator.

D. Bid Alternate No. 4: Storage Caging

1. Provide wire mesh storage caging within Storage 116.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for products selected under an alternate.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

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 that is part of web-based Project management software and acceptable to 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. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.

- h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from authority having jurisdiction.
 - j. 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.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. 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.
 - m. 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 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 15 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: Not allowed.

C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

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 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.
- b. Requested substitution does not require extensive revisions to the Contract Documents.
- c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- d. Substitution request is fully documented and properly submitted.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. 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 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 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.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on web-based Project management software.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect 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 Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request 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 acceptable to Architect and form provided as part of web-based Project management software.
- 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 Architect.
 - 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 acceptable to Architect and form provided as part of web-based Project management software.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on form provided as part of web-based Project management software.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on form provided as part of web-based Project management software. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 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.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
 - 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 at earliest possible date, but no later than seven 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. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
6. 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.
7. 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.
8. 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.
9. 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.

1.5 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 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. Payment Application Times: Submit Application for Payment to Architect by the 14th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
 - 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use 00 62 76 BGS Application for Payment 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.
- E. 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.
- F. 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.

- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect 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.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
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.
- I. 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. Products list (preliminary if not final).
 5. Sustainable design action plans, including preliminary project materials cost data.
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
- J. 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.
- K. 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 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 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. 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.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 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 inbuilt facility. Keep list current at all times.

1.5 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:
 - 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.

1.6 REQUEST FOR INFORMATION (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 Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect 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 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 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. Use software log that is part of web-based Project management software. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 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 response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven 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. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
- B. Web-Based Project Management Software Package: Provide, administer, and use 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, Architect, and Architect's consultants.
 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.
- 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 and Architect, within three days of the meeting.

- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before start of construction, at a time convenient to Owner and Contractor, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, 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. Preparation of Record Documents.
 - o. Use of the premises and existing building.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. 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, 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. Possible conflicts.
 - i. Compatibility requirements.
 - j. Time schedules.
 - k. Weather limitations.
 - l. Manufacturer's written instructions.
 - m. Warranty requirements.
 - n. Compatibility of materials.
 - o. Acceptability of substrates.
 - p. Temporary facilities and controls.
 - q. Space and access limitations.
 - r. Regulations of authorities having jurisdiction.
 - s. Testing and inspecting requirements.
 - t. Installation procedures.
 - u. Coordination with other work.
 - v. Required performance results.
 - w. Protection of adjacent work.
 - x. 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. Progress Meetings: Conduct progress meetings at biweekly regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority 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) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of Proposal Requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) 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 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. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- 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. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Daily Construction Reports: Submit at weekly intervals.
- F. Material Location Reports: Submit at weekly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.
- H. Unusual Event Reports: Submit at time of unusual event.

1.4 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.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that is capable of managing construction schedules.
- B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting, using CPM scheduling.
 - 1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
- C. Time Frame: Extend schedule from date established for the Notice to Proceed 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.
- D. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. 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. Punch list.
 3. 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.
 - a. HVAC equipment.
 4. 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.
 5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 6. Commissioning Time: Include no fewer than 15 days for commissioning.
 7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 8. Punch List and Final Completion: Include not more than 14 days for completion of punch list items and Final Completion.
- E. 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. 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.
 2. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Uninterruptible services.
 - b. Partial occupancy before Substantial Completion.
 - c. Use-of-premises restrictions.
 - d. Environmental control.
 3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Submittals.

- b. Purchases.
 - c. Fabrication.
 - d. Sample testing.
 - e. Deliveries.
 - f. Installation.
 - g. Tests and inspections.
 - h. Adjusting.
 - i. Curing.
 - j. Building flush-out.
 - k. Startup and placement into final use and operation.
 - l. Commissioning.
- 4. 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.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.
 - d. Completion of electrical installation.
 - e. Substantial Completion.
- F. 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.
- G. 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.
- H. Distribution: Distribute copies of approved schedule to Architect 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.

1.6 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. Material Location Reports: At weekly and monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List to be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. 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.

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 file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - 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 and Project area and sequential numbering suffix.

1.4 CONSTRUCTION PHOTOGRAPHS

- A. 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.
- B. 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 Architect.
- C. 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.
 - 5. Waterproofing and weather-resistant barriers.
- D. Periodic Construction Photographs: Take 20 photographs monthly. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take 50 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

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 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. 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 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 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 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. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. 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.
 4. 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 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 Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.

16. Signature of transmitter.

- B. Options: Identify options requiring selection by 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 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. 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 reserves 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 Architect'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. Architect 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.
- 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 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.

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. 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.
 4. 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.
 5. 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 will return submittal with options selected.
- D. 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.

E. 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.

F. 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.

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.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project management software. 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 will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required.
 - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 - 2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect 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.

- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review 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 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, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed 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. 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.
- E. 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.

- F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- G. 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."
- H. 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.
- I. 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.

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 regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to 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 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 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.

1.8 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. 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.

- G. **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.
- H. **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.
- I. **Specialty Mockups:** See Section 014339 "Mockups" for additional construction requirements for exterior mockups.

1.9 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.
- 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.
 - 3. Notify testing agencies at least 48 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, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, 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. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. 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.

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 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. State 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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014339 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

- A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior mockups.
2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
3. Review locations and extent of mockups.
4. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups.

1. Include plans, elevations, sections, and mounting, attachment, and support details.
2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
3. Include site location drawing.
4. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.

1.5 QUALITY ASSURANCE

A. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.
5. Perform preconstruction testing, such as window air- and water-leakage testing.

B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

C. Notifications:

1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
2. Allow seven days for initial review and each re-review of each mockup.

D. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
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.

1.6 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 INTEGRATED EXTERIOR MOCKUPS

- A. Construct integrated exterior mockups according to approved mockup Shop Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.
- B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.
- C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.
- D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.
- E. The Work of integrated exterior mockups includes, but is not limited to, the following:
 - 1. Precast architectural concrete.
 - 2. Masonry veneer.
 - 3. Air and weather barriers.
 - 4. Through-wall flashing.
 - 5. Flashing and sheet metal trim.
 - 6. Joint sealants.
 - 7. Aluminum windows.
 - 8. Glazing.
- F. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 013233 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.
- G. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.
- H. Retain approved mockups constructed in place. Incorporate fully into the Work.

PART 3 - EXECUTION (Not Used)

END OF SECTION 014339

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste-handling procedures.
 - 5. Other dust-control measures.
- F. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:
 - 1. Methods used to meet the goals and requirements of Owner.
 - 2. Concrete cutting method(s) to be used.
 - 3. Location of construction devices on the site.
 - 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 - 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

2.2 TEMPORARY FACILITIES

A. Field Offices:

1. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of [10] <Insert number> individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
3. Drinking water and private toilet.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
- B. Waste Disposal Facilities:
 - 1. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
 - 2. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 3. Protect air-handling equipment.
- D. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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 012300 "Alternates" for products selected under an alternate.
 - 3. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 4. Section 014200 "References" for applicable industry standards for products specified.
 - 5. 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.

- 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. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. 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.
- 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," Architect 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.
- 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.
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.

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 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 Indication of approval in web-based Project management software. 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, 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 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 Architect of locations and details of cutting and await directions from

- Architect 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. Fire separation assemblies.
 - b. Fire-suppression systems.
 - c. Plumbing piping systems.
 - d. Mechanical systems piping and ducts.
 - e. Control systems.
 - f. Communication systems.
 - g. Fire-detection and -alarm systems.
 - h. Electrical wiring systems.
 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.
 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 Architect'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.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

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, 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. 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 in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

3.4 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 Architect. Fit exposed connections together to form hairline joints.

3.5 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.

3.6 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 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.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 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.

3.9 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 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.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. 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.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the 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. Concrete.
 - b. Concrete reinforcing steel.
 - c. Brick.
 - d. Concrete masonry units.
 - e. Wood studs.
 - f. Wood joists.
 - g. Plywood and oriented strand board.
 - h. Wood paneling.
 - i. Wood trim.
 - j. Rough hardware.
 - k. Insulation.
 - l. Doors and frames.
 - m. Door hardware.
 - n. Windows.
 - o. Glazing.
 - p. Metal studs.
 - q. Gypsum board.
 - r. Acoustical tile and panels.
 - s. Carpet.
 - t. Carpet pad.
 - u. Equipment.
 - v. Cabinets.
 - w. Plumbing fixtures.
 - x. Piping.
 - y. Supports and hangers.
 - z. Valves.
 - aa. Sprinklers.
 - bb. Mechanical equipment.
 - cc. Refrigerants.
 - dd. Electrical conduit.
 - ee. Copper wiring.
 - ff. Lighting fixtures.

- gg. Lamps.
 - hh. Ballasts.
 - ii. Electrical devices.
2. Construction Waste:
- a. Masonry and CMU.
 - b. Lumber.
 - c. Wood sheet materials.
 - d. Wood trim.
 - e. Metals.
 - f. Roofing.
 - g. Insulation.
 - 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 the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. 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.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and 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 installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- E. Plumbing Fixtures: Separate by type and size.
- F. Lighting Fixtures: Separate lamps by type and protect from breakage.
- G. 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 shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to 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 the maximum extent practical according to 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. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Clean and stack undamaged, whole masonry units on wood pallets.
- B. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- C. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- E. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

- F. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- G. 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.
- 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 according to 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 Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
- D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

- A. General: 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. Except as 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: Do not burn waste materials.

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 Architect. 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 Architect'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 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 pest-control final inspection report.
 5. 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 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.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. MS Excel Electronic File: Architect will return annotated file.
 - b. PDF Electronic File: Architect will return annotated file.
 - c. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect 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.
- 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.
1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

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. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - d. 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.
 - e. Remove debris and surface dust from limited-access spaces, including roofs, , shafts, equipment vaults, attics, and similar spaces.

- f. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
- g. Vacuum and mop concrete.
- h. 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.
- i. Remove labels that are not permanent.
- j. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- k. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- l. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- m. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- n. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- o. Clean strainers.
- p. Leave Project clean and ready for occupancy.

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.

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 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 Architect. Enable reviewer comments on draft submittals.
 - 2. Submit three paper copies. Architect will return two copies.

- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect 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 will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect'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 Architect.
 7. Name and contact information for Commissioning Authority.
 8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 9. 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 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.

1.7 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. 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.
- I. 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.
- 1.8 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/or 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 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.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Product Data.
- 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.

1.3 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) Architect 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.
- B. 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.

1.4 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 Construction 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. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
 2. Format: Annotated PDF electronic file with comment function enabled.

3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
4. Refer instances of uncertainty to Architect for resolution.
5. Architect will furnish Contractor 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.

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 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 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 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 instructor and videographer.
- 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 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 PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- C. 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 required content of instruction.
 3. 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 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.

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. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- B. 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 with at least seven days' advance notice.
- C. 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.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
 - 1. Submit video recordings on thumb drive.
 - 2. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged in accordance with Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

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, phasing requirements, and hazardous materials information.
2. Section 017300 "Execution" for cutting and patching procedures.

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. Survey of Existing Conditions: Submit survey.
- B. Proposed Protection Measures: Submit report 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.
- C. 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. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed in accordance with EPA regulations. Include name and address of technician and date refrigerant was recovered.
- E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Universal certified by an EPA-approved certification program.

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.
- C. Notify Architect 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 included in Limited Hazardous Materials Assessment (May 2, 2024) and Supplemental Hazardous Materials Assessment (June 20, 2024) for review and use. Examine report to become aware of locations where hazardous materials are present.
 - a. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified in Limited Hazardous Materials Assessment (May 2, 2024) and Supplemental Hazardous Materials Assessment (June 20, 2024).
 - b. 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. Existing warranties include the following:
 - 1. Roof.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video, measured drawings and templates. 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 Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- B. 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. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- D. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment in accordance with 40 CFR 82 and regulations of authorities having jurisdiction.

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. Arrange to shut off utilities with utility companies.
 - 2. 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.
 - 3. 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.
 - 4. 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.
 - 5. 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 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. The use of cutting torches within the work area or building is prohibited.
4. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
5. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
6. 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.
- 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. Floor removal will require hazardous material abatement.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction 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. 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 034500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast architectural concrete units.
2. Mold materials.
3. Reinforcing materials.
4. Concrete materials.
5. Stainless steel connection materials.
6. Accessories.
7. Grout materials.

B. Related Requirements:

1. Section 085113 "Aluminum Windows" for windows set into architectural precast concrete units.

1.2 DEFINITIONS

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish, and texture, preapproved by Architect.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Precast architectural concrete unit design mixtures: Include compressive strength and water-absorption tests for each precast concrete mixture.

B. Shop Drawings:

1. Detail fabrication and installation of architectural precast concrete units.
2. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
3. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
4. Indicate relationship of architectural precast concrete units to adjacent materials.
5. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and indicate modified areas on Shop Drawings. Do not adversely affect the appearance, durability, or strength of units.

- C. Samples: Design reference samples for initial verification of design intent, representative of finish, color, and texture; approximately 6 by 6 by 2 inches. Deliver to project site for Architect verification in the field.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground or other rehandling.
- B. Support units during shipment on nonstaining shock-absorbing material.
- C. Store units with adequate dunnage and bracing, and protect units to prevent contact with soil, prevent staining, and prevent cracking, distortion, warping, or other physical damage.
- D. Place stored units so identification marks are clearly visible, and units can be inspected.
- E. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design architectural precast concrete units.
- B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120 applicable to types of architectural precast concrete units indicated.
- C. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
 - 1. Loads: As indicated.
 - 2. Design precast concrete units and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:
 - 3. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F.

2.2 PRECAST ARCHITECTURAL CONCRETE UNITS

- A. Provide unit types as indicated on Drawings.
- B. Source Limitations: Obtain precast architectural concrete units from single fabricator.

2.3 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, nonabsorptive material, warp and buckle free, that provides continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

- B. Form Liners: Units of face design, texture, arrangement, and configuration to match those used for precast concrete design reference sample. Provide solid backing and supports to keep form liners in place during concrete placement.
 - 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. Architectural Polymers, Inc.
 - b. Fitzgerald Formliners.
 - c. Sika Corporation.
 - d. Spec Formliners, Inc.
 - 2. Face Pattern: Smooth.
- C. Form-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- D. Surface Retarder: Chemical-set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.4 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or Type III.
- B. Supplementary Cementitious Materials:
 - 1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
 - 2. Silica Fume: ASTM C1240, with optional chemical and physical requirement, white.
 - 3. Ground Granulated Blast-Furnace Slag: ASTM C989/C989M, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33/C33M, with coarse aggregates complying with Class 5S. S
 - 1. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.
- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117 and ASTM C1602/C1602M.
- E. Air-Entraining Admixture: ASTM C260/C260M, certified by manufacturer to be compatible with other required admixtures.

2.6 STAINLESS STEEL CONNECTION MATERIALS

- A. Stainless Steel Plate: ASTM A240/A240M or ASTM A666, Type 304, Type 316, or Type 201.
- B. Stainless Steel Bolts and Studs: ASTM F593, Alloy Group 1 or 2) hex-head bolts and studs; ASTM F594, Alloy Group 1 or 2 stainless steel nuts; and flat, stainless steel washers.
 - 1. Lubricate threaded parts of stainless steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless Steel-Headed Studs: ASTM A276/A276M, Alloy 304 or Alloy 316, with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

2.7 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content is to be less than 0.06 percent by weight of cement when tested in accordance with ASTM C1218/C1218M.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Use a single design mixture for units with more than one major face or edge exposed.
- B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.
- C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested in accordance with ASTM C1218/C1218M.
- E. Normal-Weight Concrete Mixtures: Proportion full-depth mixture by either laboratory trial batch or field test data methods in accordance with ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi minimum.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- F. Water Absorption: Six percent by weight or 14 percent by volume, tested in accordance with ASTM C642, except for boiling requirement.
- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

2.9 FABRICATION OF MOLDS

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
 - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Edge and Corner Treatment: Uniformly radiused.

2.10 FABRICATION OF PRECAST ARCHITECTURAL CONCRETE

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage in accordance with AWS D1.1/D1.1M and AWS C5.4.
- B. Furnish loose hardware items, including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units, as indicated on the Drawings.
- D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 - 3. Place reinforcing steel and prestressing strands to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

- E. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- F. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
- G. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.
- H. Cure concrete, in accordance with PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- I. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs comply with requirements in PCI MNL 117 and Architect's approval.

2.11 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 135 product tolerances as well as position tolerances for cast-in items.
- B. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with the following product tolerances:
 - 1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:
 - a. Plus or minus 1/8 inch.

2.12 FINISHES

- A. Exposed faces to be free of joint marks, grain, and other obvious defects. Corners, including false joints to be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved sample panels and as follows:
 - 1. As-Cast Surface Finish: Provide surfaces to match approved sample for acceptable surface, air voids, sand streaks, and honeycomb.
 - 2. Stone Facing: See "Stone Facing Materials" Article.
- B. Finish exposed top surfaces of architectural precast concrete units to match face-surface finish.
- C. Finish unexposed surfaces of architectural precast concrete units with as-cast finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PRECAST ARCHITECTURAL CONCRETE UNITS

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Connect architectural precast concrete units in position by bolting, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- C. Grouting or Dry Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

- A. Erect architectural precast concrete units level, plumb, square, and in alignment.

3.4 REPAIR

- A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 ft..
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint in accordance with ASTM A780/A780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.5 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, in accordance with precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034500

SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Concrete masonry units.
3. Concrete face brick.
4. Mortar materials.
5. Ties and anchors.
6. Embedded flashing.
7. Accessories.
8. Mortar mixes.

B. Products Installed but not Furnished under This Section:

1. Steel lintels in masonry veneer.

1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

- C. Samples for Verification: Deliver samples to site for Architect's verification in the field. For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.
2. Testing Agency: Qualified in accordance with ASTM C1093 for testing indicated.

1.6 MOCKUPS

A. Wall Mockups (Exterior Brick Veneer at Windows): Build mockups to demonstrate aesthetic effects and to set quality standards for installation.

1. Build mockup as indicated on Drawings.
2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Clean exposed faces of mockups with masonry cleaner as indicated.
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.

1.7 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. Store preblended, dry mortar mix in delivery containers on elevated platforms 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.

1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills 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 face of veneer, and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with 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 TMS 602.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain exposed masonry units, cementitious mortar components, and mortar aggregate from single source.
- B. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work.

2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
- B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW, Type FBX.
 - 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. Acme Brick Company.
 - b. Belden Brick Company (The).
 - c. Boral Bricks, Inc; Boral Limited.
 - d. Endicott Clay Products Co.
 - e. General Shale, Inc.
 - f. Glen-Gery Corporation.
 - 2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M.
 - 3. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
 - 4. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 - 5. Application: Use where brick is exposed unless otherwise indicated.
 - 6. Where shown to "match existing," provide clay face brick matching color range, texture, and size of existing adjacent brickwork.
 - 7. Color and Texture: As selected by Architect.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

2.5 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, 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.
 - 1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C91/C91M.
 - 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. Argos USA LLC.
 - b. Cemex S.A.B. de C.V.
 - c. Fairborn Cement Company.
 - d. Federal White Cement, Ltd.
 - e. Heidelberg Materials.
 - f. Holcim (US) Inc.
 - g. Lafarge North America Inc.
 - h. Lehigh White Cement Company.
 - i. Quikrete; The QUIKRETE Companies, LLC.
 - j. Sakrete; CRH Americas, Oldcastle APG.
- E. Mortar Cement: ASTM C1329/C1329M.
 - 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. Lafarge North America Inc.
- F. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime, masonry cement or mortar cement, sand, water repellents, and admixtures and complying with ASTM C1714/C1714M.
 - 1. Preblended Dry Portland Cement Mortar Mix:
 - 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) Amerimix is a trademark of Bonsal American, an Oldcastle company.
 - 2) Quikrete; The QUIKRETE Companies, LLC.
 - 3) SPEC MIX, LLC.
 - 4) Sakrete; CRH Americas, Oldcastle APG.
 - 2. Preblended Dry Masonry Cement Mortar Mix
 - 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) Amerimix is a trademark of Bonsal American, an Oldcastle company.
- 2) SPEC MIX, LLC.

G. Aggregate for Mortar: ASTM C144.

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 thick, use aggregate graded with 100 percent passing the No. 16 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.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition 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. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
 - b. GCP Applied Technologies Inc.

I. Water: Potable.

2.6 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. 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 A1064/A1064M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 304.
4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

C. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing plane in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0781-inch-thick, stainless steel sheet.
3. Fabricate wire ties from 0.187-inch- diameter, stainless steel wire unless otherwise indicated.

4. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
5. Masonry-Veneer Anchors; Vertical Slotted L-Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting vertical leg with slotted hole for wire tie.
 - 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) FERO Corporation.
 - 2) Hohmann & Barnard, Inc.
 - 3) PROSOCO, Inc.
 - 4) Wire-Bond.
6. Masonry-Veneer Anchors; Double-Pintle Plate: Rib-stiffened, sheet metal anchor section with screw holes at top and bottom, projecting horizontal leg with slots for vertical legs of double pintle wire tie.
 - 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) Heckmann Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Quality Steel and Wire LLC.
 - 4) Wire-Bond.
7. Masonry-Veneer Anchors; Slotted Plate: Sheet metal anchor section, with screw holes at top and bottom; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie. Use self-adhering tape to seal penetration behind anchor plate.
 - 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) Heckmann Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Quality Steel and Wire LLC.
 - 4) Wire-Bond.
8. Masonry-Veneer Anchors; Slotted Plate with Prongs: Sheet metal anchor section, with screw holes at top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation; and raised rib-stiffened strap, stamped into center to provide a slot between strap and base for wire tie. Use self-adhering tape to seal penetration behind anchor plate.
 - 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) Hohmann & Barnard, Inc.
 - 2) Wire-Bond.
9. Masonry-Veneer Anchors; Single-Barrel Screw: Self-drilling, single-barrel screw designed to receive wire tie.
 - 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) Heckmann Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) PROSOCO, Inc.
 - 4) Rodenhouse Inc.
 - 5) Wire-Bond.

2.7 EMBEDDED FLASHING

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
 1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 ft.. Provide splice plates at joints of formed, smooth metal flashing.
 3. Fabricate through-wall metal flashing embedded in masonry from stainless steel or copper, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
 4. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 5. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 6. Solder metal items at corners.

2.8 ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Weep/Vent Products: Use the following unless otherwise indicated:
 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
 2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
 3. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.

- C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

2.9 MORTAR 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 portland cement-lime mortar unless otherwise indicated.
 - 3. 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 C270, Property Specification. Use Type N unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type S.

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. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- B. 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.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

- E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

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 1/4 inch in a story height or 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 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
4. 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 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. Match existing joint spacing for uniform construction.
2. 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.
3. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
4. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

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, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items solidly with masonry around built-in items.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Lay CMUs with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.
 - 1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to masonry backup with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Embed tie sections, connector sections and continuous wire in masonry joints.
 - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 - 4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of CMU backup.
 - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.7 EXPANSION JOINTS

- A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form expansion joints as follows:
 - 1. Build in compressible joint fillers where indicated.
 - 2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.8 LINTELS

- A. Install steel lintels where indicated.
- B. Provide offset angle supports where indicate and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are indicated without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
 - 3. At lintels and shelf angles, extend flashing 6 inches minimum, to edge of next full unit at each end. At heads and sills, extend flashing 6 inches minimum, to edge of next full unit and turn ends up not less than 2 inches to form end dams.

4. Interlock end joints of sawtooth sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 5. Install metal drip edges with sawtooth sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
 7. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
 8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- D. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
1. Use specified weep/cavity vent products to form weep holes.
 2. Space weep holes 24 inches o.c. unless otherwise indicated.
 3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
 4. Trim wicking material flush with outside face of wall after mortar has set.
- E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- C. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.
- D. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.

- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- F. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.

3.11 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. 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.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. 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 brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.12 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. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste.

3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042613

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel railings.

1.2 COORDINATION

- 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.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Fasteners.
3. Post-installed anchors.
4. Handrail brackets.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, 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 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

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.
 - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 2-1/4-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL RAILINGS

- 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. Hollaender Mfg. Co.
 - 2. Kee Safety, Inc.
 - 3. Trex Commercial Products, Inc.
 - 4. TrueNorth Steel.
 - 5. Tuttle, a Dant Clayton Division.

6. VIVA Railings, LLC.
7. Wagner Companies (The); R&B Wagner, Inc.

- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- C. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
- D. Pipe: ASTM A53/A53M, 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.
- E. Plates, Shapes, and Bars: ASTM A36/A36M.
- F. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.4 FASTENERS

- A. Fastener Materials:
 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
 2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
 3. Finish exposed fasteners to match appearance, including color and texture, of railings.
- 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 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: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast stainless steel, center of handrail as indicated on Drawings.
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- 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. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- F. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- G. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. 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.

2.6 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. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. 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 are exposed to weather in a manner that excludes water.

1. Provide weep holes where water may accumulate.
 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with 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 welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.
- I. Form changes in direction as follows:
1. By bending to smallest radius that will not result in distortion of railing member.
- J. 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.
- K. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- L. 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.
- M. 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.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 2. Coordinate anchorage devices with supporting structure.
- O. 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.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize steel railings, including hardware, after fabrication.
2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are 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 and as follows.

1. Comply with SSPC-SP 16.

D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

E. 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 for shop painting. Apply at spreading rates recommended by coating manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
6. 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.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. 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.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. 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.

3.3 ANCHORING POSTS

- A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, 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 nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.
- E. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:
 1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.

3.4 ATTACHING RAILINGS

- A. Attach handrails to walls with wall brackets. Provide brackets with 2-1/4-inch clearance from inside face of handrail and finished wall surface.
 - 1. Use type of bracket with predrilled hole for exposed bolt anchorage.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets to building construction as follows:
 - 1. For hollow masonry anchorage, use toggle bolts.

3.5 REPAIR

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

3.6 CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.7 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.
- B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Fire-retardant-treated lumber.
3. Plywood backing panels.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content:
1. Boards: 19 percent.

2. Dimension Lumber: 15 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Furring.
 4. Grounds.
 5. Utility shelving.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
 1. Hem-fir (north); NLGA.
 2. Mixed southern pine or southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.
 4. Hem-fir; WCLIB or WWPA.
 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 6. Western woods; WCLIB or WWPA.
 7. Northern species; NLGA.
 8. Eastern softwoods; NeLMA.
- C. Utility Shelving: Lumber with 19 percent maximum moisture content of any of the following species and grades:
 1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; No. 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
 2. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 3. Hem-fir or hem-fir (north); Select Merchantable or No. 1 Common grade; NLGA, WCLIB, or WWPA.
 4. Spruce-pine-fir (south) or spruce-pine-fir; Select Merchantable or No. 1 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 4. Eastern softwoods; No. 2 Common grade; NeLMA.
 5. Northern species; No. 2 Common grade; NLGA.
 6. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.
- E. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

- F. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.3 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.4 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
 - 2. For redwood, use stainless steel fasteners.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 as appropriate for the substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

- E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- F. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.
- G. Do not splice structural members between supports unless otherwise indicated.
- H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- I. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- J. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 123623.13 "Plastic-Laminate-Clad Countertops."

1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

- C. Samples for Initial Selection: For each type of exposed finish.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: 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. Manufacturer's Certification: Licensed participant in AWT's Quality Certification Program.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

- A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets 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 cabinets 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.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
- B. Architectural Woodwork Standards Grade: Premium.
- C. Type of Construction: Frameless.

- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality 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. ABET Inc.
 - b. Formica Corporation.
 - c. Laminart LLC.
 - d. Pionite; a Panolam Industries International, Inc. brand.
 - e. Wilsonart LLC.
- F. Exposed Surfaces:
 - 1. Plastic-Laminate Grade: VGS.
 - 2. Edges: Grade VGS.
 - 3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, ISO 4586-3.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
 - b. Edges of Thermally Fused Laminate Panel Shelves: PVC or polyester edge banding.
 - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, ISO 4586-3, grade to match exposed surface.
 - d. Where indicated on exposed shelving, wrap edges in plastic laminate matching the shelf surface
 - 2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
 - 3. Drawer Bottoms: Thermally fused laminate panels.
- H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3, grade to match exposed surface.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued dovetail joints.

- K. 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 laminate manufacturer's full range in the following categories:
 - a. Solid colors, gloss OR matte finish.
 - b. Solid colors with core same color as surface, matte finish.
 - c. Wood grains, matte finish.
 - d. Patterns, matte finish.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Particleboard (Medium Density): ANSI A208.1, Grade M-2.
2. Softwood Plywood: DOC PS 1, medium-density overlay.
3. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."

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. Accuride International Inc.
- b. CompX International, Inc.
- c. Grass America.
- d. Hardware Resources.
- e. Hettich America L.P.
- f. Julius Blum & Co., Inc.
- g. Knappe & Vogt Manufacturing Company.

- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 100 degrees of opening, self-closing.

- C. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.

- D. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.
- E. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.
- F. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
- G. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
- H. Drawer Slides: ANSI/BHMA A156.9.
 - 1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
 - a. Type: Full extension.
 - b. Material: Zinc-plated ball bearing slides.
 - c. Motion Feature: Push to open and Self-closing mechanism.
 - 2. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
- I. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
 - 1. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
 - 2. Satin Stainless Steel: ANSI/BHMA 630.
- K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. 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.

2.5 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

- B. Complete fabrication, including assembly and hardware application, 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.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, 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.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips and toggle bolts through metal backing or metal framing behind wall finish.

3.3 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 Architectural Woodwork Standards for the specified grade.

1. Inspection entity is to prepare and submit report of inspection.

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Loose-fill insulation.

B. Related Requirements:

1. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of 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. For blown-in or sprayed wood-fiber and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
2. Sign, date, and post the certification in a conspicuous location on Project site.

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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than Class A, 25 and 450 when tested in accordance with ASTM E84.

B. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.
- C. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- D. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
- E. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 LOOSE-FILL INSULATION

- A. Wood-Fiber Loose-Fill Insulation: ASTM C739, chemically treated for flame-resistance, processing, and handling characteristics. Type I for pneumatic application.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
 - a. TimberFill by Timber HP.
- B. Cellulosic-Fiber Loose-Fill Insulation (Bid Alternate BA1): ASTM C739, chemically treated for flame-resistance, processing, and handling characteristics Type I for pneumatic application.
 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. Greenfiber, LLC.
 - b. Hamilton Manufacturing, Inc. (HMI).
 - c. Nu-Wool Co., Inc.

2.3 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.
- 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. 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 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..
- B. Loose-Fill Insulation: Apply in accordance with ASTM C1015 and manufacturer's written instructions.
 - 1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
 - 2. For cellulosic-fiber loose-fill insulation, comply with CIMA's Technical Bulletin #2, "Standard Practice for Installing Cellulose Building Insulation."

3.4 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. Mildew-resistant joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant 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. 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.

1.3 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.

B. Installer's special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

1.5 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.

1.6 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.

1.7 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 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.

2.2 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.

2.3 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.

2.4 URETHANE JOINT SEALANTS

- A. 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.

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.6 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: 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.

- B. Cylindrical Sealant Backings: ASTM C1330, 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.

2.7 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, nonabsorbent 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. 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.
 - 2) Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.
 - 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.

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.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:

1. Section 081416 "Flush Wood Doors."
2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/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 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 7. Details of anchorages, joints, field splices, and connections.
 8. Details of accessories.
 9. Details of moldings, removable stops, and glazing.
- D. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.
- E. Product Schedule: For hollow-metal doors and 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.

1.5 QUALITY ASSURANCE

- A. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and 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 doors and 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 HOLLOW METAL DOORS AND FRAMES

- 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. Airtec Corporation.
 2. Apex Industries, Inc.
 3. BARON Metal Industries, Inc.; ASSA ABLOY of Canada, Ltd.; ASSA ABLOY.

4. Ceco Door; AADG, Inc.; ASSA ABLOY.
5. Concept Frames, AADG, Inc.; ASSA ABLOY Group.
6. Curries, AADG, Inc.; ASSA ABLOY Group.
7. Custom Metal Products.
8. Daybar Industries, Ltd.
9. DCI Hollow Metal on Demand.
10. DE LA FONTAINE.
11. Deansteel Manufacturing Company, Inc.
12. Deronde Products.
13. DKS Steel Door & Frame Systems, Inc.
14. Fleming Door Products Ltd.; ASSA ABLOY Group.
15. Gensteel Doors.
16. HMF Express.
17. Hollow Metal Xpress.
18. JR Metal Frames, Inc.
19. Karpen Steel Custom Doors & Frames.
20. L.I.F. Industries, Inc.
21. LaForce, LLC.
22. MegaMet Industries.
23. Mesker Door; Mesker Openings Group.
24. Metropolitan Door Industries Corp.
25. Michbi Doors Inc.
26. MPI Group, LLC (The).
27. National Custom Hollow Metal Doors & Frames.
28. North American Door Corp.
29. Philipp Manufacturing Co (The).
30. Pioneer Industries; AADG, Inc.; ASSA ABLOY.
31. Premier Products, Inc.
32. Republic Doors and Frames; a Allegion brand.
33. Rocky Mountain Metals, Inc.
34. Security Metal Products; a brand of ASSA ABLOY.
35. Steelcraft; Allegion plc.
36. Steward Steel, Door & Frame Division.
37. Stiles Custom Metal, Inc.
38. Titan Metal Products.
39. Trillium Steel Doors Limited.
40. West Central Manufacturing, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. when tested in accordance with ASTM C1363 or ASTM E1423.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. At locations indicated in the Door and Frame Schedule on Drawings.

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule on Drawings.
- b. Thickness: 1-3/4 inches.
- c. Face: Uncoated steel sheet, minimum thickness of 0.032 inch.
- d. Edge Construction: Model 1, Full Flush.
- e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
- f. Core: Manufacturer's standard.

2. Frames:

- a. Materials: Uncoated steel sheet, minimum thickness of 0.042 inch.
- b. Construction: Knocked down in metal framing and face welded in CMU.

3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule on Drawings.
- b. Thickness: 1-3/4 inches.
- c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A60 coating.
- d. Edge Construction: Model 2, Seamless.
- e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
- f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
- g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
- h. Core: Manufacturer's standard.

2. Frames:

- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
- b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.5 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.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.6 MATERIALS

A. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

F. 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.

G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 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. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
 - 1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
 - 2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 - 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 - 4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.8 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 ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory Finish (Exterior Doors and Frames): Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with ANSI/SDI A250.3.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

- C. Field Finish (Interior Doors and Frames): Comply with requirements in Section 099124 "Interior Painting."

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 doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. 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.
 - a. 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.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Solidly pack mineral-fiber insulation inside frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - 5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

- d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. 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.

3.4 REPAIR

- 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. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
2. Light frames.

B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.
2. Section 099124 "Interior Painting (MPI Standards)" for field finishing doors.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Solid-core five-ply flush wood veneer-faced doors for transparent finish.

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 trim for openings.
5. Door frame construction.
6. Factory-machining criteria.
7. Factory- finishing specifications.

C. 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 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 finished and application requirements.
10. Apply AWI Quality Certification Program label to Shop Drawings.

- D. Samples for Initial Selection: For factory-finished doors.

1.3 CLOSEOUT SUBMITTALS

- A. Special warranties.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

1.5 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.

1.6 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install doors until spaces are enclosed and weathertight, 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.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors 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.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WT's "Architectural Woodwork Standards."

2.3 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:

- 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. Lynden Door, Inc.
- c. Masonite Architectural.
- d. Oregon Door.
- e. Oshkosh Door Company.
- f. VT Industries, Inc.
- g. Wilsonart LLC.

- 2. Performance Grade by Location:

- a. ANSI/WDMA I.S. 1A Extra Heavy Duty: Public toilets, janitor's closets, assembly spaces, and exits.
- b. ANSI/WDMA I.S. 1A Standard Duty: Everywhere except where heavy duty are called out.

- 3. ANSI/WDMA I.S. 1A Quality Grade: Premium.
- 4. Architectural Woodwork Standards Quality Grade: Premium.
- 5. Faces: Single-ply wood veneer not less than 1/50 inch thick.

- a. Species: Select white birch, Select white maple or Walnut.
- b. Cut: Plain sliced (flat sliced).
- c. Match between Veneer Leaves: Slip match.
- d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
- e. Room Match:

- 1) Provide door faces of compatible color and grain within each separate room or area of building.

- 6. Core for Non-Fire-Rated Doors:

- a. Glued wood stave
 - b. WDMA I.S. 10 structural composite binder.
 - 1) Screw Withdrawal, Door Face: 475 lbf.
 - 2) Screw Withdrawal, Vertical Door Edge: 475 lbf.
 - c. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.4 LIGHT FRAMES

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
- 1. Wood Species: Same species as door faces.

2.5 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.
- 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.
- 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."

2.6 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.
 - 3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

- B. Factory finish doors.
- C. Transparent Finish:
 - 1. Architectural Woodwork Standards Grade: Premium.
 - a. System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
 - 2. Staining: As selected by Architect from manufacturer's full range.
 - 3. Sheen: Satin.

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 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

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 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.

B. Related Requirements:

1. Section 230600 "Heating, Ventilating, and Air Conditioning" for heating and air-conditioning duct access doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Product Schedule: For access doors and frames.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges:

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. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. Cendrex Inc.
 - d. Elmdor; Morris Group International, Inc.
 - e. JL Industries; Activar Construction Products Group, Inc.
 - f. Karp Associates, Inc.
 - g. Lane-Aire Manufacturing Corp.
 - h. Larsen's Manufacturing Company.
 - i. MIFAB, Inc.
 - j. Maxam Metal Products Limited.
 - k. Metropolitan Door Industries Corp.
 - l. Milcor by Duravent; Duravent Group.

- m. Nystrom, Inc.
 - n. Williams Brothers Corporation of America.
- 2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
 - 3. Optional Features: Piano hinges.
 - 4. Locations: Wall and ceiling.
 - 5. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
 - 6. Frame Material: Same material and thickness as door.
 - 7. Latch and Lock: Prepared for mortise cylinder.

B. Aluminum Flush Access Doors:

- 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. ACUDOR Products, Inc.
 - b. Babcock-Davis.
 - c. Cendrex Inc.
 - d. Lane-Aire Manufacturing Corp.
 - e. MIFAB, Inc.
 - f. Metropolitan Door Industries Corp.
 - g. Milcor by Duravent; Duravent Group.
 - h. Williams Brothers Corporation of America.
- 2. Description: Aluminum extrusion with tile backer fitted in door panel.
- 3. Optional Features: Gasketing with tile removable doors.
- 4. Locations: Wall.
- 5. Aluminum Sheet for Door: Nominal 0.045 inch, with mill finish.
- 6. Frame Material: Same material, thickness, and finish as door.
- 7. Latch and Lock: Prepared for mortise cylinder.

2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Aluminum Extrusions: ASTM B221, Alloy 6063.
- D. Aluminum Sheet: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- E. Frame Anchors: Same material as door face.
- F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock and key all locks alike.
 - 3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."
- E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.4 FINISHES

- 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: 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.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum windows.

1.2 DEFINITIONS

- A. Combination Assemblies: An assembly formed by a combination of two or more separate fenestration products whose frames are mullied together utilizing a combination mullion or reinforcing mullion.
- B. Combination Mullions: A horizontal or vertical member formed by joining two or more individual fenestration units together without a mullion stiffener.
- C. Reinforcing Mullions: A horizontal or vertical member with an added continuous mullion stiffener and joining two or more individual fenestration units along the sides of the mullion stiffener.

1.3 COORDINATION

- A. Finish Matching: Coordinate all exposed exterior aluminum components and trim to ensure uniform and consistent color and appearance. Use products specified in this section as a benchmark. Architect's decision will be final as to whether a proposed product matches.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes.
- B. Shop Drawings:
1. Plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.
- D. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.
- B. Installer Qualifications: Authorized representative who is trained and approved by aluminum window manufacturer.

1.7 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. Build mockup as indicated on Drawings.
 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver aluminum windows to Project site in original, unopened packages and store them in accordance with manufacturer's written instructions. Protect aluminum windows against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle aluminum windows in a manner that prevents damage before, during, and after installation.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install aluminum windows outside of limits recommended in writing by manufacturer.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures, including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
2. Warranty Period:
 - a. Window: 10 years from date of Substantial Completion.
 - b. Glazing Units: 10 years from date of Substantial Completion.
 - c. Hardware: Three years from date of Substantial Completion.
 - d. Aluminum Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain aluminum windows from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 1. Window Certification: FGIA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 1. Minimum Performance Class: AW.
 2. Minimum Performance Grade: 40.
 3. Mull Window Systems: Evaluate and rate combination assemblies as single systems as determined by AAMA 450 in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 requirements.
- C. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
 1. Thermal Transmittance (U-factor): As determined in accordance with NFRC 100:
 - a. Fixed Windows: Not more than 0.42 Btu/sq. ft. x h x deg F.
 - b. Operable Windows: Not more than 0.54 Btu/sq. ft. x h x deg F.
 2. Solar Heat-Gain Coefficient (SHGC): As determined in accordance with NFRC 200:
 - a. Fixed Windows: Not more than 0.23.

- b. Operable Windows: Not more than 0.23 as determined in accordance with NFRC 200.
- 3. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance in accordance with AAMA 1503, showing a CRF of 45.
- D. Thermal Movements: Provide aluminum windows, including anchorage, which allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.
- E. Outdoor-Indoor Transmission Class (OITC): Rated for not less than 26 OITC when tested for laboratory sound transmission loss in accordance with ASTM E90 and determined by ASTM E1332.

2.3 ALUMINUM WINDOWS

- 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. All Seasons Architectural Windows Mfg., Inc.; All Seasons Commercial Division, Inc.
 - 2. All Weather Architectural Aluminum.
 - 3. AluminTechno, LLC.
 - 4. Arcadia Inc.
 - 5. Boyd Aluminum Mfg. Co.
 - 6. Custom Window Systems, Inc.
 - 7. DeSCo Architectural, Inc.
 - 8. EFCO Corporation.
 - 9. Gerkin Windows & Doors.
 - 10. Graham Architectural Products Corporation.
 - 11. Kawneer Company, Inc.; Arconic Corporation.
 - 12. Kolbe Windows & Doors.
 - 13. Manko Window Systems, Inc.
 - 14. Mannix.
 - 15. OldCastle BuildingEnvelope (OBE).
 - 16. Peerless Products Inc.
 - 17. Quaker Windows and Doors.
 - 18. Thermal Windows, Inc.
 - 19. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.
 - 20. Winco Window Company, Inc.
 - 21. YKK AP America Inc.
- B. Provide manufacturer's standard aluminum window assemblies consisting of frames, sashes, glass, hardware, fasteners, and all components and accessories as required for a complete installation.

- C. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Projected, awning.
 2. Fixed.
- D. Frames and Sashes: Aluminum extrusions of alloy, temper, and strength complying with AAMA/WDMA/CSA 101/I.S.2/A440.
1. Thermally Broken Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- E. Glazing System: Manufacturer's standard insulating glass unit factory-glazing system that produces weathertight seal. Comply with applicable requirements in Section 088000 "Glazing."
- F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- G. Window Hardware: Projected.
1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested in accordance with ASTM E405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
 - a. Type and Style: As selected by Architect from manufacturer's full range of types and styles.
 2. Hinges: Non-friction type, not less than two per sash.
 3. Lock: Lever handle and cam-action lock with keeper.
 4. Limit Devices: Concealed support arms with adjustable, limited, hold-open limit devices designed to restrict sash opening.
- H. Weather Stripping: Provide manufacturer's standard full-perimeter weather stripping for each operable sash unless otherwise indicated.
- I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Avoid exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- J. Mullions: Provide manufacturer's standard combination and reinforcing mullions and cover plates matching window units, complete with anchors for support to structure. Allow for erection tolerances and provide for movement of window units due to thermal expansion and

building deflections. Provide reinforcing mullions and cover plates capable of withstanding design wind loads of window units.

2.4 ACCESSORIES

- A. Dividers (False Muntins): Provide manufacturer's standard extruded-aluminum divider grilles in designs indicated for each sash lite.
 - 1. Type: Permanently located between insulating-glass lites.
 - 2. Pattern: As indicated on Drawings.
 - 3. Profile: As selected by Architect from manufacturer's full range.
- B. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
- C. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- D. Panning Trim: Profiles in sizes and configurations indicated on Drawings.

2.5 INSECT SCREENS

- A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
 - 1. Type and Location: Full, inside for projected, awning sashes.
- B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
 - 1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
- C. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch-diameter, coated aluminum wire.
 - 1. Wire-Fabric Finish: Black.

2.6 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Weather strip each operable sash to provide weathertight installation.
- C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- D. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

- E. Window Assemblies: Provide window units in configuration indicated on Drawings. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
 - 1. Combination and reinforcing mullions with interior and exterior trim.
 - 2. Interior and exterior extension and trim.
 - 3. Exterior head and sill casings and trim.
- F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA AMP 500 "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: Noticeable variations in same piece are unacceptable. 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.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, air and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Mullions: Install combination and reinforcing mullions for combination assemblies in accordance with manufacturer's written instructions.
- D. Install windows and components to drain water passing joints and condensation to the exterior.
- E. Separate aluminum from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

3.4 CLEANING AND PROTECTION

- A. Clean exposed surfaces immediately after installing windows using manufacturer's written instructions. Avoid damaging finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately in accordance with manufacturer's written instructions.

END OF SECTION 085113

SECTION 087100 - FINISH HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:
 - a. Swinging doors.
2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.

1.2 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.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- D. 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

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. 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.
- D. Keying Schedules: Keying shall be performed by Owner.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware schedule.

1.6 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up 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. State of Maine, BGS Lock Shop
Attn: Gary Tibbetts
15 Columbia St.
Augusta, ME 04330

1.8 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. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers: Only hardware manufactured by one of the companies indicated below shall be accepted for use in the Project, and acceptance is limited only to the category of hardware for which the manufacturer is specified or listed as an acceptable equal.
 1. Hinges: McKinney, Stanley

2. Electrified Hinges, Power Transfers: Marray, SDC (Security Door Controls, Sargent, Von Duprin, Keedex, Securitron
3. Exit Devices: Sargent, Von Duprin
4. Door Closers: LCN, Sargent
5. Power Door Operators: Horton, no substitutes
6. Door Stops: Glynn Johnson, Ives, Rockwood
7. Push/Pulls: Rockwood, Burns, Ives
8. Protective Plates: Rockwood, Burns, Ives
9. Thresholds, Weather-stripping, Rain Drips: NGP, Pemko, Reese
10. Silencers: Rockwood
11. Power Supplies: Altronix unless otherwise specified
12. Magnetic Locks: Securitron, Schlage
13. Keys and Cores: KABA, no substitutions
14. Key Cabinet: Telkee

2.2 PERFORMANCE REQUIREMENTS

- A. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Electrically Operated and/or Controlled Hardware:
 1. All Power Supplies shall be centrally located with the associated Access Control Panel and not individually at each opening.
 2. All Power Supplies are to be mains powered from generator circuits when available.
- B. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- C. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
 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 (22.2 N).
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) 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 KEYS AND CORES

- A. All Key Blanks and Cores shall be drop shipped:

1. State of Maine, BGS Lock Shop
Attn: Gary Tibbetts
15 Columbia St.
Augusta, ME 04330
2. Products:
 - a. Cores: KABA 3850-25-1007 PK1
 - b. Keys: KABA 3800-00-0003-PK1-C95W21

2.4 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 1. All exterior or interior with Access Control System shall be NRP (Non-Removable Pin) design
- B. ELECTRIFIED HINGES, POWER TRANSFER
 1. Products:
 - a. Marray TEF2+4
 - b. SDC PTH2-4
 - c. Securitron EPT, CEPT
 - d. Von Duprin EPT2
 - e. Keedex K-DL38A

2.5 DOOR CLOSERS

- A. Approved Products:
 1. Exterior: LCN 4040XP -CUSH Sargent 281-CPS
 2. Interior: LCN 4040XP 1461 Sargent 281-0
LCN 1461 Sargent 281-P9

2.6 POWER DOOR OPERATOR (LOW ENERGY)

- A. General:
 1. Shall be integrated with Access Control System on controlled openings
 2. All actuator buttons shall be hardware wired, no wireless accepted.
- B. Approved Product: Horton 4100 series for exterior door applications and Horton 7100 series for interior door applications.
- C. Refer to Section 087113 "Power Door Operators" for additional product and installation requirements.

2.7 EXIT DEVICES

A. Approved Products: Sargent

1. Functions:

- a. 70-56-8806-ETL
- b. 70-56-8506-ETL
- c. 70-12-56-06-ETL
- d. 70-8806-ETL
- e. 70-12-8806-ETL
- f. 8815-ETL
- g. 12-8815-ETL

2.8 MORTISE LEVERSETS

A. Products: Sargent 8200 Series

1. Functions:

- a. Stockroom – 70-8204-LNL ANSI F07
- b. Entry / Office – 70-8205-LNL ANSI F04
- c. Individual Office – 70-8205-LNL ANSI F04
- d. Privacy – 70-50-8267-LNL ANSI F26
- e. Elec Fail-Secure – 70-8271-LNL
- f. Elec. Fail-Safe – 70-8270-LNL
- g. Elec. Asylum Fail-Safe – 70-8272-LNL

B. Implementation:

- 2. The Shelter-In-Place “SIP Protocol” adopted by BGS/PMD requires that all rooms be lockable from the inside where possible. To this end we provide lock hardware on nearly any door that can be fitted with one without causing day to day inconvenience to employees.
 - a. Individual Offices shall be fitted with Functions B or C.
 - b. Rooms utilized by more than two people, Conference, Break, Copier rooms shall be fitted with Function C.
 - c. Restrooms, Showers, Locker, Nursing rooms shall be fitted with Function B.

2.9 ELECTROMECHANICAL LOCKS

- A. Electromechanical Locks: ANSI/BHMA A156.25, Grade 1; motor or solenoid driven; with strike that suits frame.

2.10 ELECTRIC STRIKES

A. Products:

1. For Rim Exit Devices: 9400, 9500, 9600 by HES
2. For Mortised / Cylindrical Devices: 1600 by HES

2.11 WEATHER STRIPPING

- A. Sweeps shall be of a brush design

2.12 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.13 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

2.14 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

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.

3.3 INSTALLATION

- 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.
- 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 according to 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 (750 mm) 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. Furnish permanent cores to Owner for installation.
- E. 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.
- F. 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.
- G. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 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.
 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.5 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.

3.6 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.

3.7 DOOR HARDWARE SCHEDULE

Hardware Set 1

Door 101A

1.5 Pair Heavy Duty Hinges
 1 Mortise Exit Device, Storeroom Function with Lever
 1 Powered Door Operator/Closer, interior side
 1 Electric Strike
 Weatherstripping
 Door Bottom
 1 Wall Stop
 1 Armor Plate, interior side
 Card Reader, see electrical for access control

Hardware Set 2

Door 101B

1.5 Pair Hinges
 1 Mortise Exit Device, Passage Function with Lever
 1 Closer, push side
 1 Strike
 Silencers
 1 Wall Stop
 1 Armor Plate, push side, 1 Kickplate pull side

Hardware Set 3

Door 102

1.5 Pair Hinges
 1 Mortise Lockset, Storeroom Function with Lever
 1 Strike
 Silencers
 1 Mop Plate, pull side

Hardware Set 4

Door 104A

1.5 Pair Hinges
1 Mortise Lockset, Passage Function with Lever
1 Closer, pull side
1 Strike
Silencers
1 Kickplate, push side
1 Mop Plate, pull side

Hardware Set 5

Door 104B

1.5 Pair Hinges with Electrified Power Transfer Hinge
1 Electrified Mortise Lockset, Storeroom Function with Lever, Fail-Secure – Set to Normally Locked
1 Closer, pull side
1 Strike
Silencers
1 Wall Stop
Card Reader, see electrical for access control
1 Kickplate, push side
1 Mop Plate, pull side

Hardware Set 6

Doors 105, 106

1.5 Pair Hinges
1 Mortise Lockset, Privacy Function with Lever and Occupancy Indicator
1 Closer, pull side
1 Strike
Silencers
1 Wall Stop
1 Kickplate, push side
1 Mop Plate, pull side

Hardware Set 7

Door 109

1.5 Pair Hinges
1 Mortise Lockset, Storeroom Function with Lever
1 Closer with hold open, push side
1 Strike
Silencers
1 Wall Stop
1 Armor Plate, push side
1 Mop Plate, pull side

Hardware Set 8

Door 110

1.5 Pair Hinges with Electrified Power Transfer Hinge
1 Electrified Mortise Lockset, Storeroom Function with Lever, Fail-Secure – Set to Normally Locked
1 Closer, pull side
1 Strike
Silencers
2 Armor Plates, 1 each side
Card Reader, see electrical for access control

Hardware Set 9

Door 111

1.5 Pair Hinges
1 Mortise Lockset, Entry/Office Function with Lever
1 Strike
Silencers
1 Wall Stop
1 Kickplate, push side
1 Mop Plate, pull side

Hardware Set 10

Door 112

1.5 Pair Hinges
1 Mortise Lockset, Institutional Privacy Function with Lever
1 Strike
Silencers
1 Wall Stop
1 Kickplate, push side
1 Mop Plate, pull side

Hardware Set 11

Door2 113, 114

1.5 Pair Hinges
1 Mortise Lockset, Privacy Function with Lever
1 Strike
Silencers
1 Wall Stop
1 Kickplate, push side,
1 Mop Plate, pull side

Hardware Set 12

Door 115

1.5 Pair Heavy Duty Hinges
1 Mortise Exit Device, Storeroom, No outside trim
1 Closer, interior side
1 Strike
Weatherstripping
Door Bottom
1 Kickplate, push side

Hardware Set 13

Door 116

1.5 Pair Hinges with Electrified Power Transfer Hinge
1 Electrified Mortise Lockset, Storeroom Function with Lever, Fail-Secure – Set to Normally Locked
1 Closer, push side
1 Strike
Silencers
1 Wall Stop
2 Armor Plates, 1 each side
Card Reader, see electrical for access control

Hardware Set 14

Door 129

1.5 Pair Heavy Duty Hinges with Electrified Power Transfer Hinge
1 Electrified Mortise Lockset, Storeroom Function with Lever, Fail-Secure – Set to Normally Locked
1 Closer with Hold open, interior side
1 Strike
Weatherstripping
Door Bottom
1 Armor Plate, interior side
Card Reader, see electrical for access control

END OF SECTION 087100

SECTION 087113 - POWER DOOR OPERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Power door operators for swinging doors.

1.2 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- D. For automatic door terminology, see BHMA A156.10 and BHMA A156.19 for definitions of terms.

1.3 COORDINATION

- A. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing power door operators.
- B. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.
- C. Electrical System Roughing-in: Coordinate layout and installation of power door operators with connections to the following:
1. Power supplies.
 2. Access-control system.

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 power door operators.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For power door operators.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Indicate locations of activation and safety devices.
4. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For power door operators, safety devices, and control systems, to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project and who employs a Certified Inspector.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of power door operators that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Faulty or sporadic operation of power door operator, including controls.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
 2. Warranty Period: Two years from date of Substantial Completion.

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. ASSA ABLOY Entrance Systems; ASSA ABLOY.
 2. Ditec; Entrematic; ASSA ABLOY.
 3. Door Motion Technologies, Inc.
 4. Falcon; Allegion plc.
 5. Hager Companies.
 6. Horton Automatics; Overhead Door Corporation.
 7. KM Systems, Inc.
 8. LCN; Allegion plc.
 9. NABCO Entrances, Inc.
 10. SARGENT Manufacturing Company; ASSA ABLOY.

11. STANLEY Access Technologies LLC; STANLEY Security Solutions, Inc.
12. dormakaba USA Inc.
13. record-usa.

2.2 POWER DOOR OPERATORS, GENERAL

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and in accordance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
 1. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load of 50 mph.
- B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation, including spring closing when power is off.
- C. Hinges: See Section 087100 "Door Hardware" for hinge type for each door that door operator shall accommodate.
- D. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch-thick, extruded or formed aluminum; manufacturer's standard width; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.
- E. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.
- F. 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.

2.3 POWER DOOR OPERATORS FOR SWINGING DOORS

- A. Standard: BHMA A156.10.
- B. Performance Requirements:
 1. Opening Force:
 - a. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails; not more than 15 lbf required to open door to minimum required width.
 2. Entrapment-Prevention Force: Not more than 40 lbf required to prevent stopped door in the last 10 degrees of opening from moving in the direction of opening; not more than 30 lbf required to prevent stopped door from moving in direction of closing.
- C. Configuration: Operator to control single swinging door.

1. Traffic Pattern: One way.
 2. Operator Mounting: Surface.
- D. Operation: Power opening and spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.10.
- E. Operating System: Electromechanical.
- F. Microprocessor Control Unit: Solid-state controller.
- G. Features:
1. Adjustable opening and closing speed.
 2. Adjustable opening and closing force.
 3. Adjustable backcheck.
 4. Adjustable hold-open time from zero to 30 seconds.
 5. Adjustable time delay.
 6. Adjustable acceleration.
 7. Adjustable limit switch.
 8. Obstruction recycle.
 9. Power door re-open if stopped while closing.
 10. On-off/hold-open switch to control electric power to operator.
- H. Controls: Activation and safety devices in accordance with BHMA standards.
1. Activation Device, Switch: Push-plate switch to activate door operator.
 2. Safety Device, Presence Sensor: Mounted on door header to detect pedestrians in presence zone and to prevent door from closing.
- I. Exposed Finish: Finish matching door and frame.

2.4 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Extrusions: ASTM B221.
 2. Sheet: ASTM B209.
- B. Expanded Aluminum Mesh: Expanded aluminum sheet in accordance with the geometry of ASTM F1267.
- C. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.5 CONTROLS

- A. General: Provide controls, including activation and safety devices, in accordance with BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under

normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

- B. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.
 - 1. Configuration:
 - a. Square push plate with 4-by-4-inch junction box.
 - 1) Mounting (Interior): Recess mounted, semiflush in wall.
 - 2) Mounting (Exterior): Surface mounted.
 - 2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
 - 3. Message: International symbol of accessibility and "Push to Open."
- C. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.6 ACCESSORIES

- A. Signage: As required by cited BHMA standard for type of door and its operation.
 - 1. Application Process: Operator manufacturer's standard process.
 - 2. Provide sign materials with instructions for field application when operators are installed.

2.7 FABRICATION

- A. Factory fabricate power door operators to comply with indicated standards.
- B. Form aluminum shapes before finishing.
- C. Fabricate exterior components to drain condensation and water-passing joints within operator enclosure to the exterior.
- D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.
- E. Provide metal cladding, completely covering visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

2.8 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary, protective covering before shipping.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- B. 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 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of power door operators.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before power door operator installation.
- C. Examine roughing-in for compressed-air piping systems to verify actual locations of piping connections before power door operator installation.
- D. Verify that full-height finger guards are installed at each door with pivot hinges, where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install power door operators in accordance with manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.
 - 1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
 - 2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.
- B. Controls: Install activation and safety devices in accordance with manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring in accordance with Section 261000 "Electrical."
- C. Access-Control System: Connect operators to access-control system, see Electrical
- D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

3.3 FIELD QUALITY CONTROL

- A. Certified Inspector: Engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Test and inspect each power door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.
- C. Power door operators will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust power door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
 - 1. Adjust operators on exterior doors for tight closure.
- B. After completing installation of power door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.
- C. Readjust power door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).
- D. Occupancy Adjustment: 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 power door operators.

END OF SECTION 087113

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
1. Insulating glass.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of adjoining framing system.

- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Install glazing in mockups specified in Section 085113 "Aluminum Windows" to match glazing systems required for Project, including glazing methods.
 - 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. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain tinted and coated glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
1. Design Wind Pressures: As indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - b. Basic Wind Speed: 90 mph.
 - c. Importance Factor: 1.0.
 - d. Exposure Category: C.
 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 3. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 2. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
 3. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
 4. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.
- F. Acoustic Performance:
1. Exterior Glazing: 33 OITC.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. NGA Publications: "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.
1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

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. AGC Glass Company North America, Inc.
 - b. Cardinal Glass Industries, Inc.
 - c. Guardian Glass LLC.
 - d. Pilkington North America; NSG Group.
 - e. Saint-Gobain Glass Corp.
 - f. Vitro Architectural Glass.
- B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- D. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.
 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. Cardinal Glass Industries, Inc.
 - b. Guardian Glass LLC.
 - c. Pilkington North America; NSG Group.
 - d. Saint-Gobain Glass Corp.
 - e. Vitro Architectural Glass.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.
 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 2. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

- A. General:
 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.
- B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, 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. Pecora Corporation.
 - c. Sika Corporation.
 - d. The Dow Chemical Company.
 - e. Tremco Incorporated.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks:
1. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. Type recommended in writing by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch-minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

- A. Immediately after installation, remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.7 MONOLITHIC GLASS SCHEDULE

- A. Clear Glass Type GL-1 (for interior applications unless noted otherwise): Fully tempered float glass.
 1. Minimum Thickness: 6 mm.
 2. Safety glazing required.

3.8 INSULATING GLASS SCHEDULE

- A. Low-E-Coated, Tinted Insulating Glass Type GL-2 (for exterior applications unless noted otherwise):
 1. Basis-of-Design Product: Solarban 70 (2) Optigray + Clear by Vitro Architectural Glass.
 2. Overall Unit Thickness: 1 inch.
 3. Minimum Thickness of Each Glass Lite: 6 mm.
 4. Outdoor Lite: Heat-strengthened float glass.
 5. Interspace Content: Air.
 6. Indoor Lite: Heat-strengthened float glass (obscure privacy float glass where indicated on Drawings).
 7. Low-E Coating: Sputtered on second or third surface.
 8. Winter Nighttime U-Factor: 0.28 maximum.
 9. Summer Daytime U-Factor: 0.26 maximum.
 10. Visible Light Transmittance: 46 percent minimum.
 11. SGHC: 0.23 maximum.
 12. Safety glazing required.

END OF SECTION 088000

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed extruded-aluminum louvers.
2. Blank-off panels for louvers

B. Related Requirements:

1. Section 099114 (MPI Standards) "Exterior Painting" for field painting exterior louvers.

1.2 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).
- C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 WARRANTY

- A. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, peeling, or chipping.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fixed and operable louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.
 - 1. Wind Loads:
 - a. Determine loads based on pressures as indicated on Drawings.
 - b. Determine loads based on a uniform pressure of 30 lbf/sq. ft., acting inward or outward.
- B. Seismic Performance:
 - 1. Louvers, including attachments to other construction, withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

- C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal Drainable-Blade Louver, Extruded Aluminum:
 - 1. Louver Depth: 4 inches.
 - 2. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
 - 3. Mullion Type: Exposed.
 - 4. Louver Performance Ratings:
 - a. Free Area: Not less than 7.5 sq.ft. for 48-inch-wide by 48-inch-high louver.
 - b. Point of Beginning Water Penetration: Not less than 1000 fpm.
 - c. Air Performance: As indicated on Drawings.
 - 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Insect screening.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
 - 2. Finish: Mill finish unless otherwise indicated.
 - 3. Type: Rewirable frames with a driven spline or insert.
- D. Louver Screening for Aluminum Louvers:
 - 1. Insect Screening, Aluminum: 18-by-16 mesh, 0.012-inch wire.

2.5 BLANK-OFF PANELS

- A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
 - 1. Thickness: 1 inch.
 - 2. Metal Facing Sheets, Aluminum: Not less than 0.032-inch nominal thickness.
 - 3. Insulating Core: Rigid, glass-fiber-board insulation.
 - 4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
 - 5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 - 6. Panel Finish: Same finish applied to louvers.
 - 7. Attach blank-off panels with clips.

2.6 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
 - 3. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless steel fasteners.
 - 4. For fastening stainless steel, use 300 series stainless steel fasteners.
 - 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless steel components, with allowable load or strength design capacities calculated in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing in accordance with ASTM E488/E488M conducted by a qualified testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.7 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Channel unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
 - 1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
- F. Provide subsills made of same material as louvers for recessed louvers.
- G. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for 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. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Framing systems.
 - 2. Suspension systems.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Framing systems.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Horizontal Deflection: For composite and non-composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft..

2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with AISI S220 and ASTM C645, Section 10 for conditions indicated.
 - 1. Steel Sheet Components: Comply with AISI S220 and ASTM C645, Section 10 requirements for metal unless otherwise indicated
 - 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- C. Studs and Track: AISI S220 and ASTM C645, Section 10.
 - 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. CEMCO; California Expanded Metal Products Co.
 - b. CRACO Mfg., Inc.
 - c. ClarkDietrich.
 - d. Jaimes Industries, Inc.
 - e. MBA Building Supplies.
 - f. MBA Metal Framing.
 - g. MRI Steel Framing, LLC.
 - h. Marino\WARE.
 - i. SCAFCO Steel Stud Company; Stone Group of Companies.
 - j. Steel Construction Systems; Stone Group of Companies.
 - k. Steel Network, Inc. (The).
 - l. TELLING Industries.
 - m. UMS Metal Building Systems USA LLC.
 - 2. Minimum Base-Steel Thickness: As indicated on Drawings and as required by performance requirements for horizontal deflection.
 - 3. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch minimum vertical movement.
 - 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) CEMCO; California Expanded Metal Products Co.
 - 2) CRACO Mfg., Inc.
 - 3) ClarkDietrich.
 - 4) MBA Metal Framing.
 - 5) Marino\WARE.
 - 6) SCAFCO Steel Stud Company; Stone Group of Companies.
 - 7) Steel Construction Systems; Stone Group of Companies.
 - 8) Steel Network, Inc. (The).
 - 9) Super Stud Building Products Inc.
 2. Single Long-Leg Track System: Top track with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 3. Double-Track System: Top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 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) CRACO Mfg., Inc.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width 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. CEMCO; California Expanded Metal Products Co.
 - b. ClarkDietrich.
 - c. Jaimes Industries, Inc.
 - d. MBA Building Supplies.
 - e. MRI Steel Framing, LLC.
 - f. Marino\WARE.
 - g. Phillips Manufacturing Co.
 - h. SCAFCO Steel Stud Company; Stone Group of Companies.
 - i. Steel Construction Systems; Stone Group of Companies.
 - j. Steel Network, Inc. (The).
 - k. TELLING Industries.

- l. The Mill Steel Co.
 2. Minimum Base-Steel Thickness: As indicated on Drawings.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
 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. CEMCO; California Expanded Metal Products Co.
 - b. CRACO Mfg., Inc.
 - c. ClarkDietrich.
 - d. Jaimes Industries, Inc.
 - e. MBA Building Supplies.
 - f. MRI Steel Framing, LLC.
 - g. Marino\WARE.
 - h. Phillips Manufacturing Co.
 - i. SCAFCO Steel Stud Company; Stone Group of Companies.
 - j. Steel Construction Systems; Stone Group of Companies.
 - k. Steel Network, Inc. (The).
 - l. TELLING Industries.
 - m. The Mill Steel Co.
 - n. UMS Metal Building Systems USA LLC.
 2. Depth: 1-1/2 inches.
 3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

2.3 SUSPENSION SYSTEMS

- A. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- B. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
 1. Depth: 2-1/2 inches.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, 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 indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, 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 non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- 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 tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated 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.
 - 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.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLATION OF SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. 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.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. 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.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Seismic Bracing: Sway-brace suspension systems.

3.6 FIELD QUALITY CONTROL

- A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet 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 non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Mold-resistant gypsum board.
3. Impact-resistant gypsum board.
4. Cementitious backer units.
5. Joint treatment materials.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1.3 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.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board 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, 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.

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 GYPSUM BOARD, GENERAL

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 35 percent.
- B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. 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. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - e. PABCO Gypsum.
 - f. Panel Rey.
 - g. USG Corporation.
2. Thickness: 5/8 inch unless otherwise indicated.
3. Long Edges: Tapered.

- B. 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. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - e. PABCO Gypsum.

- f. Panel Rey.
 2. Thickness: 1/2 inch.
 3. Long Edges: Tapered.
 - C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. 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. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - e. PABCO Gypsum.
 - f. Panel Rey.
 - g. USG Corporation.
 2. Core: As indicated on Drawings.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
 - D. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested in accordance with ASTM C1629/C1629M.
 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. Continental Building Products Inc.
 - d. Georgia-Pacific Gypsum LLC.
 - e. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - f. PABCO Gypsum.
 - g. USG Corporation.
 2. Core: As indicated on Drawings.
 3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
 4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
 5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
 6. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 requirements in accordance with test in Annex A1.
 7. Long Edges: Tapered.
 8. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, 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. C-Cure.
 - b. Custom Building Products.
 - c. FinPan, Inc.
 - d. PermaBASE Building Products, LLC provided by National Gypsum Company.
 - e. USG Corporation.
 - 2. Thickness: 1/2 inch at full height tile locations; match thickness of adjacent GWB at wainscot locations.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Paper-faced galvanized-steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. J-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. Expansion (control) joint.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions 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. Flannery, Inc.
 - b. Fry Reglet Corporation.
 - c. Gordon Inc.
 - d. Pittcon Industries.
 - e. Tamlyn.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
 - 3. Finish: Match existing aluminum storefront finishes.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended 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, 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 drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 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 by panel manufacturer.
- C. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

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.
- 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.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: As indicated on Drawings.
 - 2. Ceiling Type: Soffit and ceiling locations, unless noted otherwise.
 - 3. Mold-Resistant Type: Walls and ceilings, where occur, in shower and custodial rooms.
 - 4. Impact-Resistant Type: 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.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated 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 or required by fire-resistance-rated assembly.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners unless otherwise indicated.
 2. J-Bead: Use at exposed panel edges.
 3. L-Bead: Use where indicated on Drawings.
- D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

- D. Gypsum Board Finish Levels: 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."
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- 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 099114 - EXTERIOR PAINTING (MPI STANDARDS)

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. Surface preparation and application of paint systems on the following exterior substrates:
 - a. Steel and iron.
 - b. Galvanized metal.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include preparation requirements and application instructions.
 - 2. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 3. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

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 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. Behr Paint Company; Behr Process Corporation.
 2. Benjamin Moore & Co.
 3. California Paints; ICP Building Solutions Group.
 4. Conco Paints.
 5. Coronado Paint; Benjamin Moore & Co.
 6. Diamond Vogel Paint Company.
 7. Dulux Canada; a licensed product of PPG Architectural Coatings.
 8. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
 9. Hempel (USA), Inc.
 10. Insl-X Products; Benjamin Moore & Co.
 11. Kelly-Moore Paints.
 12. McCormick Paints.

13. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
14. Rodda Paint Co.
15. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
16. Valspar; a brand of The Sherwin-Williams Company.
17. Vista Paint Corporation.
18. Zinsser; Rust-Oleum Corporation.

- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior Painting Schedule for the paint category indicated.
- C. Source Limitations: Obtain paint from single source from single manufacturer.

2.2 PAINT PRODUCTS

- A. MPI Standards: Provide products complying with MPI standards indicated and listed in its "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. VOC Content: For field applications, 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. Dry-Fog Coatings: 150 g/L.
 4. Primers, Sealers, and Undercoaters: 100 g/L.
 5. Rust-Preventive Coatings: 100 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Shellacs, Clear: 730 g/L.
 9. Shellacs, Pigmented: 550 g/L.
- D. 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. Wood: 15 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. 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 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, use workers skilled in the trades involved to 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. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 3.
- E. 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.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. 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 INSTALLATION

- A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI 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 entire exposed surface of window frames and sashes.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in the Exterior Painting Schedule 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 undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. 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. Contractor shall 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, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

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 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:

- 1. Water-Based Light Industrial Coating System MPI EXT 5.1C (surface previously coated):
 - a. Alkyd Prime Coat: Primer, alkyd, anti-corrosive for metal, MPI #79.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Semigloss Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level 5), MPI #163.
- 2. Alkyd System MPI EXT 5.1D:
 - a. Alkyd Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
 - c. Semigloss Topcoat: Alkyd, exterior, semigloss (MPI Gloss Level 5), MPI #94.

B. Galvanized-Metal Substrates:

- 1. Water-Based Light Industrial Coating System MPI EXT 5.3J:
 - a. Acrylic Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Semigloss Topcoat: Light industrial coating, exterior, water based, semigloss (MPI Gloss Level 5), MPI #163.

END OF SECTION 099114

SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

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 surface preparation and the application of paint systems on interior substrates.
 - 1. Concrete.
 - 2. Concrete masonry units (CMUs).
 - 3. Steel and iron.
 - 4. Galvanized metal.
 - 5. Gypsum board.
 - 6. Wood.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches square.
 2. Apply coats on Samples in steps to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- C. Product List: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.5 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. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

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 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. Behr Paint Company; Behr Process Corporation.
 2. Benjamin Moore & Co.
 3. California Paints; ICP Building Solutions Group.

4. Conco Paints.
5. Coronado Paint; Benjamin Moore & Co.
6. Diamond Vogel Paint Company.
7. Dulux Canada; a licensed product of PPG Architectural Coatings.
8. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
9. Hempel (USA), Inc.
10. Insl-X Products; Benjamin Moore & Co.
11. Kelly-Moore Paints.
12. McCormick Paints.
13. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
14. Rodda Paint Co.
15. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
16. United Gilsonite Laboratories (UGL).
17. Valspar; a brand of The Sherwin-Williams Company.
18. Vista Paint Corporation.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. 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 shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. 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. Dry-Fog Coatings: 150 g/L.
 4. Primers, Sealers, and Undercoaters: 100 g/L.
 5. Rust-Preventive Coatings: 100 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Shellacs, Clear: 730 g/L.
 9. Shellacs, Pigmented: 550 g/L.
- D. Low-Emitting Materials: For field applications that are inside the weatherproofing system, verify 90 percent of paints and coatings 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."
- E. Colors: As indicated in finishes schedule on the Drawings and designated on Drawings.

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. Masonry (Clay and CMUs): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. 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, 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 rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 3.
- 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 sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 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 INSTALLATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI 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 painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat 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 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.

3.5 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, 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, flat (MPI Gloss Level 1), MPI #143.
- B. Concrete Substrates, Traffic Surfaces:
 - 1. Concrete Floor Sealer System, MPI INT 3.2G (areas with CONC finish floor):
 - a. First Coat: Sealer, for concrete floors, matching topcoat.
 - b. Topcoat: Sealer, for concrete floors, MPI #99.
- C. 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 (MPI Gloss Level 4), MPI #146.
- D. Steel Substrates:
 - 1. High-Performance Architectural Latex System, MPI INT 5.1R:
 - a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - b. Topcoat: Latex, interior, high performance architectural, semigloss (MPI Gloss Level 4), MPI #140.
- E. Galvanized-Metal Substrates:
 - 1. High-Performance Architectural Latex System, MPI INT 5.3M:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 4), MPI #140.

F. Gypsum Board Substrates:

- 1. Institutional Low-Odor/VOC Latex System, MPI INT 9.2M (general gypsum wall and ceiling board unless noted otherwise):
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - b. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.
- 2. Water-Based Light-Industrial Coating System, MPI INT 9.2L (gypsum ceiling board in restrooms, toilets, and showers):
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Topcoat: Light-industrial coating, interior, water based, semigloss (MPI Gloss Level 5), MPI #153.

END OF SECTION 099124

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

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 room-identification signs that are directly attached to the building.

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. 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.
- C. 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.
- D. 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.
- E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings and provided list.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 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," the ABA standards of the Federal agency having jurisdiction, and ICC A117.1.

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.

1. Product: Subject to compliance with requirements, provide product by one of the following:
 - a. ACE Sign Systems, Inc.
 - b. APCO Graphics, Inc.
 - c. ASE, Inc.
 - d. ASI Sign Systems, Inc.
 - e. Advance Corporation.
 - f. Allen Industries.
 - g. Best Sign Systems, Inc.
 - h. Clarke Systems.
 - i. Cosco.
 - j. Diskey Sign Company.
 - k. Mohawk Sign Systems.
 - l. Nelson-Harkins Industries.
 - m. Poblocki Sign Company, LLC.
 - n. Seton Identification Products; a Brady Corporation company.
 - o. Signature Signs, Inc.
 - p. Signs & Decal Corp.
 - q. Vista System, LLC.
 - r. Vomar Products, Inc.
 - s. inpro Corporation.
 - t. WelchSign.
2. Panel Sign (Type A, B, and C): Photopolymer signs for permanent rooms with raised text and Grade II Braille. Photopolymer shall be one piece material with no side seams from laminating two materials together. Photopolymer shall have a minimum 8 shore D hardness, be processed within factory recommendations via approved equipment and be moisture resistant. Signs are to be painted using acrylic polyurethane paints for background colors.
 - a. Panel Thickness: Manufacturer's standard size of sign.
 - b. Text/Symbol: Raised text/symbol color can be thermo press or silk-screened and a satin clear polyurethane topcoat added for optimal durability.
 - c. Color: As selected by Architect from manufacturer's full range to match owner's sample.
3. Mounting: Manufacturer's standard method for substrates indicated with.
4. Text and Typeface: Accessible raised characters and Braille, typeface as selected by Architect from manufacturer's full range and variable content as scheduled. 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. 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. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - 3. 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.
 - 1. Verify adhesives have a VOC content of 70 g/L or less.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

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.

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 I, 0.018 mm or thicker.

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.
- 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. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position and push to engage tape adhesive.

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 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Underlavatory guards.
4. Custodial accessories.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Underlavatory guards.
4. Custodial accessories.

B. Product Data Submittals: 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.

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.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.5 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.
- B. Manufacturer's Special Warranty for Toilet-Compartment Occupancy-Indicator Systems: Manufacturer agrees to repair or replace toilet-compartment occupancy-indicator systems that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five 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 250 lbf concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser (T-03):

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. Aluids; Krome USA Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
 2. Description: Double-roll dispenser with shelf.
 3. Mounting: Surface mounted.
 4. Operation: Noncontrol delivery with theft-resistant spindle.
 5. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- C. Combination Towel (Folded) Dispenser/Waste Receptacle (T-06):
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.
 - d. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - e. Tubular Specialties Manufacturing, Inc.
 2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
 3. Mounting: Recessed.
 - a. Designed for nominal 6-inch wall depth.
 4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
 5. Minimum Waste-Receptacle Capacity: 12 gal.
 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 7. Liner: Reusable, vinyl waste-receptacle liner.
 8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.
- D. Soap Dispenser (T-02):
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. Aluids; Krome USA Inc.

- c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - g. Seachrome Corporation.
 - h. Tubular Specialties Manufacturing, Inc.
- 2. Description: Designed for manual operation and dispensing soap in liquid or lotion form.
 - 3. Mounting: Vertically oriented, surface mounted.
 - 4. Capacity: 40 oz.
 - 5. Materials: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - 6. Lockset: Tumbler type.
 - 7. Refill Indicator: Window type.

E. Grab Bar (T-01 & T-13):

- 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. Aluids; Krome USA Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. Brey-Krause Manufacturing Co.
 - f. Construction Solutions.
 - g. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - h. Oatey Co.
 - i. ProFlo; a Ferguson Enterprises, Inc. brand.
 - j. Seachrome Corporation.
 - k. Tubular Specialties Manufacturing, Inc.
- 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.

F. Sanitary-Napkin Disposal Unit (T-07):

- 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.
 - d. Brey-Krause Manufacturing Co.

- e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Seachrome Corporation.
 - g. Tubular Specialties Manufacturing, Inc.
- 2. Mounting: Surface mounted.
 - 3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
 - 4. Receptacle: Removable.
 - 5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

G. Mirror Unit (T-04):

- 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.
 - d. Brey-Krause Manufacturing Co.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Seachrome Corporation.
 - g. Seawin Hospitality; Seawin Global.
 - h. Tubular Specialties Manufacturing, Inc.
- 2. Frame: Stainless steel, fixed tilt.
 - a. Corners: Manufacturer's standard.
- 3. Size: As indicated on Drawings.
- 4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

H. Coat Hook (T-05):

- 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.
 - d. Brey-Krause Manufacturing Co.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Seachrome Corporation.
 - g. Tubular Specialties Manufacturing, Inc.
- 2. Description: Double-prong unit.
- 3. Mounting: Concealed.
- 4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

- A. Source Limitations: Obtain public-use shower room accessories from single source from single manufacturer.
- B. Shower Curtain Rod (T-09):
 - 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.
 - d. Brey-Krause Manufacturing Co.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
 - 2. Description: 1-1/4-inch- OD, straight rod.
 - 3. Configuration: As indicated on Drawings.
 - 4. Mounting Flanges: Concealed fasteners; in material and finish matching rod.
 - 5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- C. Shower Curtain (T-09):
 - 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.
 - d. Brey-Krause Manufacturing Co.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
 - 2. Size: Minimum 12 inches wider than opening by 72 inches high.
 - 3. Material: Nylon-reinforced vinyl, minimum 9 oz. or 0.008-inch-thick vinyl, with integral antibacterial and flame-retardant agents.
 - 4. Color: As selected from manufacturer's full range.
 - 5. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
 - 6. Shower Curtain Hooks: Stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.
- D. Folding Shower Seat (T-11):
 - 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.
 - d. Brey-Krause Manufacturing Co.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Seachrome Corporation.
 - g. Tubular Specialties Manufacturing, Inc.
 2. Configuration: Rectangular seat.
 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).
 5. Dimensions: As indicated on Drawings.
- E. Robe Hook (T-12):
 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.
 - d. Brey-Krause Manufacturing Co.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Seachrome Corporation.
 - g. Tubular Specialties Manufacturing, Inc.
 2. Description: Single-prong unit.
 3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- F. Wall-Mounted Bench (T-10):
 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.
 - d. Brey-Krause Manufacturing Co.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Seachrome Corporation.
 - g. Tubular Specialties Manufacturing, Inc.
 2. Configuration: Rectangular seat.
 3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
 4. Mounting Mechanism: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 5. Dimensions: As indicated on Drawings.

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

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. Buckaroos, Inc.
 - b. Plumberex Specialty Products, Inc.
 - c. Truebro; IPS Corporation.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.5 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Custodial Mop and Broom Holder (T-08):

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.
 - d. Brey-Krause Manufacturing Co.
 - e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
 - f. Tubular Specialties Manufacturing, Inc.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
 - b. Rod: Approximately 1/4-inch-diameter stainless steel.

2.6 MATERIALS

- ### A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.

- B. 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.
- C. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 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.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- 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 123553.16 - PLASTIC-LAMINATE-CLAD LABORATORY CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad laboratory casework.
2. Auxiliary cabinets.
3. Countertops.
4. Tables.
5. Laboratory accessories.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking for anchoring laboratory casework.
2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring laboratory casework.

1.2 DEFINITIONS

- A. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.
- B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and visible surfaces in open cabinets or behind glass doors.
 1. Ends of cabinets are defined as "exposed" except ends are defined as "concealed" where installed directly against and completely concealed by walls or other cabinets.
- C. Plastic Laminate: High-Pressure Decorative Laminate (HPDL).
- D. Semiexposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cases 78 inches or more above floor and bottoms of cabinets more than 24 inches, but less than 48 inches above floor, are defined as "semiexposed."

1.3 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.
- B. Coordinate installation of laboratory casework with installation of laboratory equipment.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad laboratory casework.
2. Auxiliary cabinets.
3. Countertops.
4. Tables.
5. Laboratory accessories.

B. Shop Drawings: For laboratory casework.

1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
2. Indicate types and sizes of casework.
3. Indicate manufacturer's catalog numbers for casework.
4. Show fabrication details, including types and locations of hardware.
5. Include details of utility spaces showing supports for conduits and piping.
6. Include details of exposed conduits, if required, for service fittings.
7. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and laboratory equipment.
8. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Keying Schedule: Include schematic keying diagram, and index each key set to unique designations that are coordinated with the Contract Documents.

D. Samples for Initial Selection: For plastic laminate and other materials requiring color selection.

1.5 DELIVERY, STORAGE, AND HANDLING

- ##### A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.6 FIELD CONDITIONS

- ##### A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet-work are 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 laboratory casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- ##### C. Field Measurements: Where laboratory casework is indicated to fit to existing 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.

- D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Laboratory casework installation to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
 - 1. Design earthquake spectral response acceleration, short period (Sds) for Project is indicated on Drawings.
 - 2. Component Importance Factor: 1.0.
 - 3. Base Cabinet Load (Including Countertop and Load on Countertop): 200 lb/ft..
 - 4. Wall Cabinet (Upper Cabinet) Load: 100 lb/ft..

2.3 CASEWORK, GENERAL

- A. Casework Product Standard: Comply with SEFA 8-PL, "Laboratory Grade Plastic Laminate Casework."

2.4 PLASTIC-LAMINATE-CLAD LABORATORY CASEWORK

- 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. CIF Lab Solutions LP.
 - 2. Case Systems Inc.
 - 3. Stevens Industries, Inc.
 - 4. TMI Systems Corporation.
- B. Design:
 - 1. Flush overlay.
- C. Grain Direction for Wood Grain Plastic Laminate:
 - 1. Doors: Vertical with continuous vertical matching.
 - 2. Drawer Fronts: Vertical with continuous vertical matching.
 - 3. Face Frame Members: Lengthwise.
 - 4. End Panels: Vertical.
 - 5. Bottoms and Tops of Units: Side to side.

6. Knee Space Panels: Vertical.
7. Aprons: Horizontal.

D. Exposed Materials:

1. Plastic-Laminate Grade: VGS.
 - a. Colors and Patterns: As selected by Architect from manufacturer's full range.
2. Edgebanding: Plastic laminate matching adjacent surfaces.

E. Semiexposed Materials:

1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semiexposed surfaces, other than drawer bodies, unless otherwise indicated.
 - a. Colors and Patterns: As selected by Architect from manufacturer's full range.
 - b. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
2. Thermally Fused Laminate (TFL) Panels: Provide thermally fused laminate (TFL) panels for drawer sides, backs, and bottoms.
 - a. Colors and Patterns: As selected by Architect from manufacturer's full range.
 - b. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
3. Plywood: Hardwood plywood. Grade B faces and Grade J crossbands. Provide backs of same species as faces.
4. Metal for Steel Drawer Pans: Cold-rolled, carbon-steel sheet complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.

F. Concealed Materials:

1. Plywood: Hardwood plywood.
2. Plastic Laminate: Grade VGS concealed backs of panels with exposed plastic-laminate surfaces.
3. Hardboard for dust panels.

2.5 PLASTIC-LAMINATE CABINET MATERIALS

- A. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.

- B. Plastic Laminate: HDPL complying with ISO 4586-3.

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. ABET Inc.
 - b. Arborite, Division of Wilsonart Canada ULC.
 - c. Formica Corporation.
 - d. Laminart LLC.
 - e. Nevamar Company, LLC.
 - f. Wilsonart LLC.
- C. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper.
 1. Edgebanding for Thermally Fused Laminate (TFL) Panels: PVC or polyester edgebanding matching thermally fused laminate panels.

2.6 AUXILIARY CABINETS

- A. Tempered Glass for Glazed Doors: Clear tempered glass complying with ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.

2.7 CABINET HARDWARE

- A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, Type B01602, self-closing. Provide two for doors 48 inches high or less and three for doors more than 48 inches high.
 1. Degrees of Opening: 170.
- C. Hinged-Door and Drawer Pulls: Stainless steel, back-mounted pulls. Provide two pulls for drawers more than 24 inches wide.
 1. Design: As selected from manufacturer's full range.
 2. Overall Size: 1-3/8 by 5-1/2 inches.
- D. Door Catches: Dual, self-aligning, permanent magnet catches. Provide two catches on doors more than 48 inches high.
- E. Drawer Slides: ANSI/BHMA A156.9.
 1. Manufacturer's standard.
 2. Heavy Duty (Grade 1HD-100): Side mount.
 - a. Type: Full extension.
 - b. Material: Zinc-plated ball bearing slides.
 - c. Motion Feature: Self-closing mechanism.
 3. General-purpose drawers; provide 100 lb load capacity.

- F. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches, attached with screws or rivets. Provide where indicated.
- G. Locks: Cam type, brass with chrome-plated finish; complying with ANSI/BHMA A156.11, Type E07281 or Type E07261.
 - 1. Tumbler: Disc.
 - 2. Lock Locations: Provide where indicated.
 - 3. Keying: Key locks alike within each room; key each room separately.
 - a. Master key for up to 225 key changes.
 - 4. Key Quantity: Minimum of two keys per lock.
 - 5. Master Key System: Key locks to be operable by master key.
 - a. Master Keys: Provide two.
- H. Adjustable Shelf Supports: ANSI/BHMA A156.9, powder-coated steel shelf rests, Type B04013.

2.8 COUNTERTOPS

- A. General: Provide laboratory countertops as indicated on Drawings.
- B. Stainless Steel Sheet: ASTM A240/A240M, Type 304.

2.9 TABLES

- A. Tabletops and Shelf: Fabricate similar to countertops. Fold edge down a minimum of $\frac{3}{4}$ -inch.
 - 1. At fixed table provide shelf 12 inches fill width and length of table at a height of 12 inches above floor.
- B. Welded tubing legs, not less than 2 inches square with channel stretchers as needed to comply with product standard. Weld or bolt stretchers to legs and cross-stretchers, and bold legs to table aprons. Provide leveling device welded to bottom of each let.
 - 1. Leg Shoes: Black vinyl or rubber, open-bottom, slip-on type.
- C. Height Adjustable Table Base: Provide pneumatic height adjustable table base with paddle-style adjustment control. Provide dual synchronized pneumatic piston mechanism.

2.10 CABINET FABRICATION

- A. Construction: Provide plastic-laminate laboratory casework of the following minimum construction:
 - 1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: $\frac{3}{4}$ -inch-thick particleboard.

2. Shelves: 3/4-inch-thick plywood.
 3. Exposed Backs of Cabinets: 1/2-inch-thick particleboard or MDF.
 4. Backs of Cabinets: 1/4-inch-thick, veneer-core hardwood plywood dadoed into sides, bottoms, and tops where not exposed unless otherwise indicated.
 5. Drawer Fronts: 3/4-inch-thick particleboard.
 6. Drawer Sides and Backs: 1/2-inch-thick solid-wood or veneer-core hardwood plywood, with glued dovetail or multiple-dowel joints.
 7. Drawer Bottoms: 1/4-inch-thick hardwood plywood glued and dadoed into front, back, and sides of drawers.
 - a. Use 1/2-inch-thick material for drawers more than 24 inches wide.
 8. Doors: 3/4 inch thick, with particleboard or MDF cores.
 9. Stiles and Rails of Glazed Doors Less Than 48 Inches (1200 mm) High: 3/4 inch thick, with particleboard cores.
- B. Utility-Space Framing: Steel framing units consisting of two steel slotted channels complying with MFMA-4, not less than 1-5/8 inches square by 0.105-inch nominal thickness, that are connected at top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch steel flat bars. Framing units may be made by welding channel material into rectangular frames instead of using U-shaped brackets.
- C. Removable Backs: Provide backs that can be removed from within cabinets at utility spaces.
- D. Filler and Closure Panels: Provide where indicated and as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as adjacent exposed casework surfaces unless otherwise indicated.
1. Provide knee-space panels (modesty panels) at spaces between base cabinets, where indicated.
 2. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.
 3. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.

2.11 COUNTERTOP FABRICATION

- A. Countertops, General: Provide units with smooth surfaces in uniform plane, free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch.
- B. Stainless Steel:
1. Countertops: Made from stainless steel sheet, not less than 0.062-inch nominal thickness, with ASTM A480/A480M No. 4 satin finish.
 - a. Extend top down 1 inch at edges with a 1/2-inch return flange under frame. Apply heavy coating of heat-resistant, sound-deadening mastic to undersurface.
 - b. Form backsplash coved to and integral with top surface.
 - c. Factory punch holes for service fittings.

- d. Reinforce underside of countertop with channels, or use thicker metal sheet where necessary to ensure rigidity without deflection.
 - e. Weld shop-made joints.
 - f. Where field-made joints are required, provide hairline butt joints mechanically bolted through continuous channels welded to underside at edges of joined ends. Keep field jointing to a minimum.
 - g. After fabricating and welding, grind surfaces smooth and polish to produce uniform, directionally textured finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
2. Shelves: Made from stainless steel sheet, not less than 0.050-inch nominal thickness, with ASTM A480/A480M No. 4 satin finish. Weld shop-made joints. Fold down front edge 3/4 inch; fold up back edge 3 inches.
- a. Provide integral stiffening brackets, formed by folding up ends 3/4 inch and welding to upturned front and back edges.
 - b. After fabricating, grind welds smooth and polish to produce uniform, directionally textured finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.

2.12 LABORATORY ACCESSORIES

- A. Stainless Steel Pegboards: Stainless steel pegboards with removable polypropylene pegs and stainless steel drip troughs with drain outlet.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CASEWORK

- A. Comply with installation requirements in SEFA 2. Install level, plumb, and true in line; shim as required using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
- 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 - 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
 - 3. Variation of Faces of Casework from a True Plane: 1/8 inch in 10 feet.
 - 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

- B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.
- C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.
- D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches o.c.
- E. Install hardware uniformly and precisely.
- F. Adjust operating hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF COUNTERTOPS

- A. Comply with installation requirements in SEFA 2. Abut top and edge surfaces true in plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints where indicated on Shop Drawings.
- B. Field Jointing: Where possible, make in same manner as shop-made joints, using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.
- C. Fastening:
 - 1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
- D. Provide holes and cutouts required for service fittings.
- E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.
- F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
- G. Dress joints smooth, remove surface scratches, and clean entire surface.

3.4 INSTALLATION OF SINKS

- A. Comply with installation requirements in SEFA 2.

3.5 INSTALLATION OF LABORATORY ACCESSORIES

- A. Install accessories in accordance with Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions.
- B. Securely fasten adjustable shelving supports, stainless steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.
- C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.
- D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.6 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

END OF SECTION 123553.16

SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertops.
2. Accessories.

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 AWT'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.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Indicate locations and sizes of cutouts and holes for items installed in countertop and backsplashes.

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.

1.5 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 with Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent 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.
- C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

- A. Plastic-Laminate-Clad Countertop.
- B. Quality Standard: Unless otherwise indicated, comply with ANSI/AWI 1236 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: Premium.
- D. High-Pressure Decorative Laminate: ISO 4586-3, Grade HGS.
- 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. Wood grains, matte finish with grain running parallel to length of countertop.

c. 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: Particleboard made with exterior glue.
- 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.
- J. Paper Backing: Provide paper backing on underside of countertop substrate.

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.
 - 1. Particleboard: ANSI A208.1, MR 10.
 - a. Grade M-2 or better; complying with performance requirements specified.

2.3 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.

2.4 FABRICATION

- A. 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.
- B. 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.

- C. 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

- 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. 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 and color coordinated with top.

3.4 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 semiexposed 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 210500 - COMMON WORK REQUIREMENTS FOR FIRE SUPPRESSION

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. Packless expansion joints.
2. Alignment guides and anchors.
3. Sleeves without waterstop.
4. Sleeves with waterstop.
5. Sleeve-seal systems.
6. Grout.
7. Silicone sealants.
8. Escutcheons.
9. Floor plates.
10. Metal pipe hangers and supports.
11. Trapeze pipe hangers.
12. Thermal hanger-shield inserts.
13. Fastener systems.
14. Equipment supports.
15. Equipment labels.
16. Warning signs and labels.
17. Pipe labels.
18. Valve tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For piping and equipment identification, provide the following:
 - a. Samples: For color, letter style, and graphic representation required for each identification material and device.
 - b. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
 - c. Valve-numbering scheme.
 - d. Valve Schedules: Provide for fire-suppression piping system. Include in operation and maintenance manuals.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.

2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 1. Trapeze pipe hangers.
 2. Equipment supports.
 3. Include plans, elevations, sections, and attachment details for heating cable.
 4. Include diagrams for power, signal, and control wiring for heating cable.
- D. Delegated-Design Submittal: For trapeze hangers 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. Detail fabrication and assembly of trapeze hangers.
 2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.
- C. Sample warranties.

1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables and controls to include in operation and maintenance manuals.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. General:

1. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
2. Comply with NEMA MG 1 unless otherwise indicated.
3. Comply with IEEE 841 for severe-duty motors.

2.2 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Metraflex Company (The).
 - c. Unisource Manufacturing, Inc.
2. Source Limitations: Obtain flexible-hose packless expansion joints from single manufacturer.
3. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose, UL-listed or FM-approved.
4. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
5. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon steel fittings with threaded end connections.
 - a. Stainless steel hoses and single-braid, stainless steel sheaths with 300 psig ratings.
6. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon steel fittings with grooved end connections.
 - a. Stainless steel hoses and single-braid, stainless steel sheaths with 175 psig ratings.
7. Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon steel fittings with grooved flanged or welded end connections.
 - a. Stainless steel hoses and single-braid, stainless steel sheaths with 175 psig ratings.

2.3 SLEEVES WITHOUT WATERSTOP

- #### A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.

- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
- C. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

2.4 SLEEVES WITH WATERSTOP

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CALPICO, Inc.
 - 2. Metraflex Company (The).
- B. Description: Manufactured steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.5 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CALPICO, Inc.
 - 2. GPT; a division of EnPRO Industries.
 - 3. Metraflex Company (The).
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Designed to form a hydrostatic seal of 20 psig minimum.
 - 2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating of length required to secure pressure plates to sealing elements.

2.6 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.7 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. The Dow Chemical Company.
 - c. Tremco Incorporated.
 2. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
 3. Verify sealant has a VOC content of 250 g/L or less
 4. Verify sealant complies with the testing and product 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".
- B. Silicone, S, P, T, NT: Single-component, 100/50, pourable plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sika Corporation.
 - b. The Dow Chemical Company.
 - c. Tremco Incorporated.
 2. Standard: ASTM C920, Type S, Grade P, Class 100/50, Uses T and NT.
 3. Verify sealant has a VOC content of 250 g/L or less
 4. Verify sealant complies with the testing and product 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".

2.8 ESCUTCHEONS AND FLOOR PLATES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. BrassCraft Manufacturing Co.; a Masco company.
 2. Dearborn Brass.
 3. Keeney Manufacturing Company (The).
- B. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- C. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

- D. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- E. Split Floor Plates: Steel with concealed hinge.

2.9 PERFORMANCE REQUIREMENTS FOR HANGERS AND SUPPORTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. NFPA Compliance: Comply with NFPA 13.
- D. UL Compliance: Comply with UL 203.

2.10 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.11 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.12 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CADDY; brand of nVent Electrical plc.
 - 2. Carpenter & Paterson, Inc.
 - 3. National Pipe Hanger Corporation.
 - 4. Piping Technology & Products, Inc.
- B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.13 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved 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.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.
- B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - d. MKT Fastening, LLC.
 - 2. Indoor Applications: **[Zinc-coated]** [or] **[Stainless]** steel.
 - 3. Outdoor Applications: Stainless steel.

2.14 EQUIPMENT SUPPORTS

- A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.15 HANGERS AND SUPPORTS MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.

- E. Grout: ASTM C1107/C1107M, 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.

2.16 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Craftmark Pipe Markers.
 - 2. Pipemarker.com; Brimar Industries, Inc.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include the following:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on[**main**] distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.17 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Craftmark Pipe Markers.
 - 2. Pipemarker.com; Brimar Industries, Inc.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.04 inch thick, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass link chain.
- C. Letter and Background Color: As indicated for specific application under Part 3.

- D. 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. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 INSTALLATION OF PACKLESS EXPANSION JOINTS

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install expansion joints in accordance with EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3.2 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
 3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.3 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 1. Sleeves are not required for core-drilled holes.

- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. 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 penetrations. Seal pipe penetrations with fire- and smoke-stop materials.

3.4 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using silicone sealant, seal space around outside of sleeves.

3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.6 FIELD QUALITY CONTROL OF SLEEVES

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - 2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.7 INSTALLATION OF ESCUTCHEONS

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor plate.
 - 2. Existing Piping: Split floor plate.
- E. Using new materials, replace broken and damaged escutcheons and floor plates.

3.8 APPLICATION OF HANGERS AND SUPPORTS

- A. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- B. Hang standpipe and sprinkler piping to support the weight of the water filled pipe plus 250 pounds at the hanger.

- C. Hang horizontal fire line piping to support the weight of five times the weight of the water filled pipe plus 250 pounds at the hanger.
- D. Provide split ring hangers on exposed piping drops with rods secured to wall to eliminate movement.

3.9 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. 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. Install in accordance with approvals and listings.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. 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.
- 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, and strainers, [NPS 2-1/2] <Insert size> 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 that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.10 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.11 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.

3.12 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
 - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Division 09.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.13 GENERAL INSTALLATION REQUIREMENTS OF LABELS

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- C. Coordinate installation of identifying devices with locations of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.
- E. Locate identifying devices so that they are readily visible from the point of normal approach.

3.14 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of fire-suppression equipment.
- B. Sign and Label Colors:
 - 1. White letters on an ANSI Z535.1 safety-red background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E.

3.15 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Division 09.
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. 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. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit a view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- D. Flow- Direction Arrows: Provide arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Fire-Suppression Pipe Label Color Schedule:

1. Fire-Suppression Pipe Labels: White letters on an ANSI Z535.1 safety-red background.

3.16 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule in the operating and maintenance manual. Include the identification "FSV" on all fire-suppression system valve tags.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
 1. Valve-Tag Size and Shape:
 - a. Wet-Pipe Sprinkler System: 1-1/2 inches.
 2. Valve-Tag Color: White letters on an ANSI Z535.1 safety-red background.

3.17 SLEEVE SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 1. Interior Walls and Partitions:
 - a. Sleeves without waterstops.

3.18 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- E. Use thermal hanger-shield inserts for insulated piping and tubing.
- F. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 3.

4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
- G. Hanger-Rod Attachments: Comply with NFPA requirements.
- H. Building Attachments: Comply with NFPA requirements. 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. C-Clamps (MSS Type 23): For structural shapes.
 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- I. Saddles and Shields: Comply with NFPA requirements. 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.
- J. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- K. Use powder-actuated fasteners instead of building attachments where required in concrete construction.

END OF SECTION 210500

SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION 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. Two-piece ball valves with indicators.
 - 2. Bronze butterfly valves with indicators.
 - 3. Iron butterfly valves with indicators.
 - 4. Check valves.
 - 5. Trim and drain valves.

1.3 DEFINITIONS

- A. NRS: Nonrising stem.
- B. OS&Y: Outside screw and yoke.
- C. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set valves open to minimize exposure of functional surfaces.
- 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 operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
 - 1. Sprinkler System & Water Spray System Devices:
 - a. Valves, Trim and Drain: VQGU
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. NFPA Compliance for valves:
 - 1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.
- E. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.3 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ames Fire & Waterworks; A Watts Water Technologies Company.
2. NIBCO INC.
3. Victaulic Company.

B. Description:

1. UL 1091, except with ball instead of disc.
2. Minimum Pressure Rating: 175 psig.
3. Body Design: Two piece.
4. Body Material: Forged bronze.
5. Port Size: Full.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.4 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Reliable Automatic Sprinkler Co., Inc. (The).
2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
3. Victaulic Company.
4. Viking Group Inc.

B. Description:

1. Standard: UL 312.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.5 TRIM AND DRAIN VALVES

A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
 - c. NIBCO INC.
 - d. WATTS; A Watts Water Technologies Company.
2. Description:
- a. Pressure Rating: 175 psig.
 - b. Body Design: Two piece.
 - c. Body Material: Forged brass or bronze.
 - d. Port size: Full or standard.
 - e. Seats: PTFE.
 - f. Stem: Bronze or stainless steel.
 - g. Ball: Chrome-plated brass.
 - h. Actuator: Handlever.
 - i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
 - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
 - b. NIBCO INC.
 - c. United Brass Works, Inc.
2. Description:
- a. Pressure Rating: 175 psig.
 - b. Body Material: Brass or bronze.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

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. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION, GENERAL

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:
 - 1. Section 211310 "Fire Suppression Sprinkler Systems" for application of valves in wet- or dry-pipe, fire-suppression sprinkler systems.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply, except from fire-department connections. Install permanent identification signs, indicating portion of system controlled by each valve.
- C. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above the pipe center.
- E. Install valves in position to allow full stem movement.
- F. Install valve tags. Comply with requirements in Section 210500 "Common Work Requirements for Fire-Suppression" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 210523

SECTION 211310 - FIRE SUPPRESSION SPRINKLER 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. Section Includes:

1. Pipes, fittings, and specialties.
2. Specialty valves.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Pressure gauges.

- B. Related Requirements:

1. Section 211100 "Fire-Suppression Water-Service Piping" for fire water service backflow prevention devices.
2. Section 210523 "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe and dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

- C. Shop Drawings: For wet-pipe and dry-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, or BIM model, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.
 1. Domestic water piping.
 2. HVAC hydronic piping.
 3. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
- B. Design Data:
 1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- C. Welding certificates.
- D. Field Test Reports:
 1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 2. Fire-hydrant flow test report.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire.

2.2 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with NFPA 13.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- C. Prepare shop drawings in accordance with the Maine State Building Code.
 1. Sprinkler system design shall be approved by authorities having jurisdiction.
 - a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - b. Sprinkler Occupancy Hazard Classifications:
 - 1) Building Service Areas: Ordinary Hazard, Group 1.
 - 2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - 3) General Storage Areas: Ordinary Hazard, Group 1.
 - 4) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - 5) Office and Public Areas: Light Hazard.
 2. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

3. Maximum protection area per sprinkler according to UL listing.
4. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft..
 - b. Storage Areas: 130 sq. ft..
 - c. Mechanical Equipment Rooms: 130 sq. ft..
 - d. Electrical Equipment Rooms: 130 sq. ft..
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

2.3 STEEL PIPE AND FITTINGS

- A. Standard-Weight (Schedule 40), Galvanized- and Black- Steel Pipe: ASTM A53/A53M, Type E Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A135/A135M or ASTM A795/A795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- C. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
- D. Grooved-Joint, Steel-Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - c. Victaulic Company.
 2. Pressure Rating: 175-psig minimum.
 3. Galvanized Painted or Uncoated Grooved-End Fittings for Steel Piping: ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - c. Victaulic Company.
 2. Standard: UL 213.
 3. Pressure Rating: 175-psig minimum.
 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 5. Type: Mechanical-tee and -cross fittings.
 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing, Inc.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - d. Victaulic Company.
 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 3. Pressure Rating: 175-psig minimum.
 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 5. Size: Same as connected piping. Match sprinkler K-factor.
 6. Inlet and Outlet: Threaded or grooved.
- C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer LLC; a Division of Morris Group International.
 2. Standard: UL 199.
 3. Pressure Rating: 175 psig.
 4. Body Material: Brass.
 5. Size: Same as connected piping.
 6. Inlet: Threaded.
 7. Drain Outlet: Threaded and capped.
 8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing, Inc.
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - c. Victaulic Company.
 - d. Viking Group Inc.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aegis Technologies, Inc.
 - b. Merit Manufacturing.
2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. FlexHead Industries, Inc.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Victaulic Company.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Reliable Automatic Sprinkler Co., Inc. (The).
 2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 3. Victaulic Company.
 4. Viking Group Inc.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- D. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
 2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- E. Sprinkler Finishes: Chrome plated.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
 - c. Victaulic Company.
 - d. Viking Group Inc.
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.
- H. Sprinkler Baffles:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Roemer LLC; a Division of Morris Group International.
 2. Description: Used to prevent open sprinkler from cooling adjoining sprinklers when spaced less than 6 feet
Material: 18 inches by 18 inches

2.6 PRESSURE GAUGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AGF Manufacturing, Inc.
 - 2. Ashcroft Inc.
 - 3. Brecco Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gauge Range: 0- to 250-psig minimum.
- E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.
- C. Obtain most recent fire pump test report.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
 - 3. Install piping concealed above ceilings and within furred spaces.
 - 4. Install risers within pipe chases.
 - 5. Obtain approval from the Architect for piping locations which require furrings not indicated on the Contract Drawings.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
 - 1. Install inspector's test assemblies for each flow switch.
 - 2. Install inspector's test assemblies at the most remote point of system with drain piped to test drain stack.
 - 3. Install inspector's test assemblies with 6 feet 8 inches minimum clearance from the finish floor to a maximum of 7 feet (2134 mm) to the centerline of the piping.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install alarm devices in piping systems.
- I. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- J. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- K. Fill sprinkler system piping with water.
- L. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500 "Common Work Requirements for Fire-Suppression."
- M. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500 "Common Work Requirements for Fire-Suppression."
- N. Install flexible couplings on both sides of piping penetrations through structural components, such as walls, floors, beams, and foundations.
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500 "Common Work Requirements for Fire-Suppression."

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. 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.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Grooved Joints, General: Install in accordance with the manufacturer's latest published installation instructions.
 - 1. Grooved ends shall be clean and free from indentations, projections, and roll marks.
 - 2. Gaskets shall be molded and produced by the coupling manufacturer and shall be verified as suitable for the intended service.
 - 3. A factory-trained field representative (direct employee) of the mechanical joint manufacture shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products.
 - 4. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed.
 - 5. Contractor shall remove and replace any improperly installed products.
 - 6. A distributor's representative is not considered qualified to conduct the training.
- J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

3.5 SPRINKLER INSTALLATION

- A. Sprinkler spacing, densities, and system design shall comply with NFPA 13.
- B. Provide new sprinklers to match the Response Time Index (RTI) of the existing sprinklers in renovated compartments. If the RTI of existing sprinklers cannot be determined, replace all sprinklers in the compartment.
- C. Install sprinklers in finish ceilings with return bend drops.
- D. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- E. Align sprinklers suspended ceilings with ceiling components such as lighting fixtures, diffusers and smoke detectors.
- F. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.
- G. Provide additional sprinklers as required by NFPA 13, including the Annex, to protect areas where ceiling sprinkler spray pattern is obstructed and below ducts and equipment 4 feet or wider. Sprinkler layouts in rooms with exposed ductwork shall be based on the approved ductwork submittals and final coordination drawings.
 - 1. Obstructions created by multiple small obstructions such as piping and cable trays shall be protected with additional intermediate sprinklers located below the obstructions where the ceiling sprinkler spray pattern cannot spray on both sides of an obstruction.
 - 2. Where ceiling sprinkler deflectors are less than 18 inches above the obstruction: Provide intermediate level sprinklers with integral water shields below obstructions.
 - 3. Where sprinkler deflectors are more than 18 inches above the obstruction: Provide intermediate sprinklers with integral water shields to protect below multiple obstructions such as ductwork, piping and cable trays when the aggregate is wider than 4 feet.
- H. Sprinkler Guards: Provide listed sprinkler guards on exposed upright and pendent sprinklers in areas subject to damage, including in the following locations:
 - 1. Within 24 inches of cable trays.
 - 2. Information services, telephone, and communication rooms.

3. Electrical rooms and closets.
 4. Server rooms.
 5. Within 6 foot 8 inches above the finished floor.
- I. Provide upright sprinklers within stair towers to protect each floor landing.
 - J. Electrical Closets and Equipment Rooms: Coordinate piping layouts with the final equipment layout in compliance with the National Electrical Code. Provide sprinkler spray baffles to shield direct water spray from electrical equipment.
 - K. Provide intermediate sprinklers with water shield and listed cage guards on sprinklers installed below 6 foot 8 inches above the finished floor.
 - L. Provide sprinklers with temperature rating to suit the ambient temperature of the space that it is installed.
 - M. Provide sprinkler protection throughout combustible concealed spaces.

3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Energize circuits to electrical equipment and devices.
 5. Start and run air compressors.
 6. Coordinate with fire-alarm tests. Operate as required.
- B. Sprinkler System: Perform all testing in accordance with NFPA 13.
 1. Hydrostatic Testing: Perform hydrostatic tests at 200 psi for at least 2 hour.
 2. Operational Testing: Perform testing of water flow switches and associated alarm systems by water flow through the inspector's test assemblies.

3. Main Drain Test: Perform main drain valve flow test and submit static and residual pressures with pitot readings at the discharge terminal.
- C. Operating Working Test: Perform test and complete Contractor's material and test certificate.
- D. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

- A. Install and maintain the manufacturer's protective sprinkler shields or caps on installed sprinklers until all finish work is completed and accepted by the Architect.
- B. Install temporary protective coverings such as cellophane or thin paper bags over sprinklers during painting and fireproof spraying procedures. The use of tape or aluminum foil as a protective covering is strictly prohibited.
- C. Remove protective coverings and sprinkler shields or caps after all painting and finish work is completed and accepted by the Architect.
- D. Clean dirt and debris from sprinklers.
- E. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 PIPING SCHEDULE

- A. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller shall be one of the following:
 1. Standard-weight (Schedule 40), black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight (Schedule 40), black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 shall be one of the following:
 1. Standard-weight (Schedule 40), black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight (Schedule 40), black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 3. Thinwall or Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.10 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
 3. Wall Mounting: Sidewall sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated. Refer to the architectural reflected ceiling plans for requirements for custom colors.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

END OF SECTION 211310

SECTION 220500 - COMMON WORK REQUIREMENTS 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.

1.2 SUMMARY

A. Section Includes:

1. General requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Alignment guides and anchors.
3. Sleeves without waterstop.
4. Sleeves with waterstop.
5. Stack-sleeve fittings.
6. Sleeve-seal systems.
7. Grout.
8. Silicone sealants.
9. Escutcheons.
10. Floor plates.
11. Thermometers, liquid in glass, lead free.
12. Thermowells, lead free.
13. Pressure gauges, dial type, lead free.
14. Gauge attachments, lead free.
15. Test plugs, lead free.
16. Metal pipe hangers and supports.
17. Trapeze pipe hangers.
18. Metal framing systems.
19. Thermal hanger-shield inserts.
20. Fastener systems.
21. Pipe stands.
22. Pipe-positioning systems.
23. Equipment supports.
24. Equipment labels.
25. Warning signs and labels.
26. Warning tape.
27. Pipe labels.
28. Valve tags.

B. Related Requirements:

1. Section Division 05 for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 221100 " Water Piping and Specialties" for water meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Identification:
 - a. Samples: For color, letter style, and graphic representation required for each identification material and device.
 - b. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
 - c. Valve-numbering scheme.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.
- C. Sample warranties.

1.5 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.

1.6 CLOSEOUT SUBMITTALS

- #### A. Maintenance Data: For expansion joints.

- B. Operation and Maintenance Data: For thermometers and gauges to include in operation and maintenance manuals.
- C. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection 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.

2.4 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides: .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASC Engineered Solutions.
 - b. Flex-Hose Co., Inc.
 - c. Metraflex Company (The).
2. Source Limitations: Obtain alignment guides from single manufacturer.
3. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A36/A36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
3. Washers: ASTM F844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated carbon steel.
 - c. Washer and Nut: Zinc-coated carbon steel.

2.5 SLEEVES WITHOUT WATERSTOP

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
- C. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

2.6 SLEEVES WITH WATERSTOP

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CALPICO, Inc.

2. Metraflex Company (The).

- B. Description: Manufactured steel, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.7 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CALPICO, Inc.
 2. GPT; a division of EnPRO Industries.
 3. Metraflex Company (The).
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Designed to form a hydrostatic seal of 20 psig minimum.
 2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Carbon steel.
 4. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating of length required to secure pressure plates to sealing elements.

2.8 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.9 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.
 - b. The Dow Chemical Company.
 - c. Tremco Incorporated.
 2. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

3. Verify sealant has a VOC content of 250 g/L or less.
4. Verify sealant complies with the testing and product 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."

2.10 ESCUTCHEONS AND FLOOR PLATES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. BrassCraft Manufacturing Co.; a Masco company.
 2. Dearborn Brass.
 3. Keeney Manufacturing Company (The).
- B. Escutcheons:
 1. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
 2. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
 3. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- C. Floor Plates:
 1. Split Floor Plates: Cast brass with concealed hinge.

2.11 PERFORMANCE REQUIREMENTS FOR THERMOMETERS AND GAUGES

- A. All items in this Section in contact with water for human consumption, are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.12 THERMOMETERS, LIQUID IN GLASS, LEAD FREE

- A. Thermometers, Liquid in Glass, Lead Free - Metal Case, Compact Style:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Miljoco Corporation.
 - b. Trerice, H. O. Co.
 2. Source Limitations: Provide liquid-in-glass, lead-free, metal-case, compact-style thermometers by single manufacturer.
 3. Standard: ASME B40.200.

4. Case: Cast aluminum; 6-inch nominal size.
5. Case Form: Back angle unless otherwise indicated.
6. Tube: Glass with magnifying lens and blue or red organic liquid, mercury-free.
7. Tube Background: Nonreflective aluminum with permanent scale markings graduated in deg F.
8. Window: Glass or plastic.
9. Stem: Aluminum or lead-free brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
10. Connector: 3/4 inch, with ASME B1.1 or ASME B1.20.1 screw threads to fit thermowell.
11. Accuracy: Plus or minus 1 percent of span or one scale division, to a maximum of 1.5 percent of span.

2.13 PRESSURE GAUGES, DIAL TYPE, LEAD FREE

A. Pressure Gauges, Dial Type, Lead Free - Direct Mounted, Metal Case:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Terice, H. O. Co.
 - c. WIKA Instrument Corporation.
 - d. Weiss Instruments, Inc.
2. Source Limitations: Provide dial-type, lead-free, direct-mounted, metal-case pressure gauges from single manufacturer.
3. Standard: ASME B40.100.
4. Case: Liquid-filled type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
5. Pressure-Element Assembly: Lead-free bourdon tube.
6. Pressure Connection: Lead-free brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanent scale markings graduated in psi.
9. Pointer: Dark-colored metal.
10. Window: Glass.
11. Ring: Metal.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of span.

2.14 GAUGE ATTACHMENTS, LEAD FREE

- A. Snubbers: ASME B40.100, lead-free 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: Lead-free brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.15 TEST PLUGS, LEAD FREE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Trerice, H. O. Co.
 - 2. Weiss Instruments, Inc.
 - 3. Weksler Glass Thermometer Corp.
- B. Source Limitations: Provide lead-free test plugs from single manufacturer.
- C. Description: Test-station fitting made for insertion into piping tee fitting.
- D. Body: Lead-free brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- E. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
- F. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- G. Core Inserts: Chlorosulfonated polyethylene synthetic self-sealing rubber.

2.16 PERFORMANCE REQUIREMENTS FOR HANGERS AND SUPPORTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.17 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, hot-dip galvanized, or electro-galvanized.
 - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
 - 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 made of carbon steel.
- B. 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 made of stainless steel.

2.18 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.19 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.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - d. MKT Fastening, LLC.
 2. Indoor Applications: Zinc-coated steel.

2.20 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 3. Hardware: Galvanized steel or polycarbonate.
 4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
5. Pipe Supports: Roller.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads.

D. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.21 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.22 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.23 MATERIALS FOR HANGERS AND SUPPORTS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, 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.

2.24 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Craftmark Pipe Markers.
 - b. Pipemarket.com; Brimar Industries, Inc.
 - c. Seton Identification Products; a Brady Corporation company.
2. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 3. Letter and Background Color: As indicated for specific application under Part 3.
 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 6. Fasteners: Stainless steel rivets or self-tapping screws.
 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.25 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Craftmark Pipe Markers.
 2. Pipemarket.com; Brimar Industries, Inc.
 3. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.26 WARNING TAPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Craftmark Pipe Markers.
 - 2. Pipemarker.com; Brimar Industries, Inc.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch.
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F.
- G. Minimum Width: 2 inches.

2.27 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Craftmark Pipe Markers.
 - 2. Pipemarker.com; Brimar Industries, Inc.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.28 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Craftmark Pipe Markers.
 - 2. Pipemarket.com; Brimar Industries, Inc.
 - 3. Seton Identification Products; a Brady Corporation company.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass link chain.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. 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. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS - GENERAL

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 INSTALLATION OF PACKLESS EXPANSION JOINTS

- A. Install rubber packless expansion joints in accordance with FSA-PSJ-703.

3.3 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9.
 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-58, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
1. Anchor Attachment to Steel Structural Members: Attach by welding.
 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
 3. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.4 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. 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 penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in [**Section 078413 "Penetration Firestopping."**] [**Division 07.**]

3.5 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeves.

3.6 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.7 INSTALLATION OF ESCUTCHEONS AND FLOOR PLATES

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
 - d. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
 - e. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor plate.
 - 2. Existing Piping: Split floor plate.
- E. Using new materials, replace broken and damaged escutcheons and floor plates.

3.8 INSTALLATION OF THERMOMETERS AND GAUGES

- A. Install thermometer with thermowell at each required thermometer location.
- B. Install thermowells in vertical position in piping tees.
- C. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- H. Install valve and snubber in piping for each pressure gauge for fluids.
- I. Install test plugs in piping tees.
- J. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlet and outlet of each domestic hot-water storage tank.
 - 3. Outlet side of hot-water-balancing valve, within 3 ft..
 - 4. Each main hot-water-recirculating line return pipe.
- K. Install thermometers and gauges adjacent to machines and equipment to allow service and maintenance of thermometers, gauges, machines, and equipment.
- L. After installation, calibrate thermometers according to manufacturer's written instructions.
- M. Adjust faces of thermometers and gauges to proper angle for best visibility.

3.9 APPLICATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Division 07 for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.10 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. 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.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 for curbs.
- G. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic 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.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and 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.
- M. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. 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 of same thickness as piping insulation.

3.11 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 bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.12 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.13 ADJUSTING HANGERS AND SUPPORTS

- 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.

3.14 PAINTING HANGERS AND SUPPORTS

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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 a 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 A780/A780M.

3.15 INSTALLATION OF IDENTIFICATION, GENERAL REQUIREMENTS

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with locations of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

- E. Locate identifying devices so that they are readily visible from the point of normal approach.

3.16 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E.

3.17 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.18 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Division 09.
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. 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. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation.
- E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- F. Pipe-Label Color Schedule:

1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
3. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background.
4. Sanitary Waste and Storm Drainage Piping: White letters on a black background.
5. Nonpotable Cold Water: Black letters on an ANSI Z535.1 safety-yellow background.

3.19 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff 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 in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
 1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 1-1/2 inches,.
 - b. Domestic Hot Water: 1-1/2 inches,.
 - c. Domestic Hot-Water Return: 1-1/2 inches,.
 - d. Nonpotable Cold Water: 1-1/2 inches,.
 2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.20 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections of heating cables.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect heating cable components, assemblies, and equipment installations, including connections.
- D. Prepare test and inspection reports.

3.21 SLEEVE SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
 - a. Sleeves with waterstops.
4. Interior Partitions:
 - a. Sleeves without waterstops.

3.22 THERMOMETER, LEAD FREE, SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater are to be the following:

1. Metal case, industrial style, liquid-in-glass type.

3.23 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 10. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- 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. V-channel Shields (MSS Type 40): Continuous length to support plastic and flexible pipe systems. Install on clevis hangers (MSS Type 1) with V-bottom.
 4. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners instead of building attachments where required in concrete construction.
- Q. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220500

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. Bronze ball valves.
 - 2. Bronze lift check valves.
 - 3. Bronze swing check valves.
 - 4. Bronze swing check valves, press ends.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and soldered ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.

4. Set butterfly valves closed or slightly open.
 5. Set gate valves closed to prevent rattling.
 6. Set 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 operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
 2. ASME B16.5 for flanges on steel valves.
 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 4. ASME B16.18 for solder-joint connections.
 5. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- E. 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.
- F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valves in Insulated Piping:
1. Ball Valves:
 - a. Include 2-inch stem extensions.
 - b. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - c. Memory stops that are fully adjustable after insulation is applied.

2. Butterfly Valves: With 2-inch stem extensions.
3. Gate Valves:
 - a. RS Valves in Insulated Piping: With 2-inch stem extensions.

I. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. NIBCO INC.
 - c. WATTS; A Watts Water Technologies Company.
 - d. Zurn Industries, LLC.
2. Description:
 - a. Standard: MSS SP-110 or MSS-145.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

B. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. NIBCO INC.
 - c. Viega LLC.
 - d. Zurn Industries, LLC.
2. Description:
 - a. Standard: MSS SP-110 or MSS-145.
 - b. CWP Rating: Minimum 200 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Press.

- f. Press Ends Connections Rating: Minimum 200 psig.
- g. Seats: PTFE or RTPFE.
- h. Stem: Bronze or brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.
- k. O-Ring Seal: EPDM or Buna-N.

C. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. NIBCO INC.
 - c. Viega LLC.
 - d. WATTS; A Watts Water Technologies Company.
- 2. Description:
 - a. Standard: MSS SP-110 or MSS-145.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded or soldered.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.

D. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. NIBCO INC.
 - c. Viega LLC.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Regular.

E. Bronze Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. NIBCO INC.
 - c. Viega LLC.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Regular.

2.3 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

A. Ductile Iron, Grooved-End Butterfly Valves, 175 CWP:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Kennedy Valve Company; a division of McWane, Inc.
 - c. NIBCO INC.
 - d. Zurn Industries, LLC.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.

B. Ductile Iron, Grooved-End Butterfly Valves, 300 CWP:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Kennedy Valve Company; a division of McWane, Inc.
 - c. NIBCO INC.
 - d. WATTS; A Watts Water Technologies Company.

2. Description:

- a. Standard: MSS SP-67, Type I.
- b. CWP Rating, NPS 8 and Smaller: 300 psig.
- c. CWP Rating, NPS 10 and Larger: 200 psig.
- d. Body Material: Coated, ductile iron.
- e. Stem: Two-piece stainless steel.
- f. Disc: Coated, ductile iron.
- g. Seal: **[EPDM]** **[NBR]**.

2.4 BRONZE, SWING CHECK VALVES

A. Bronze, Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Stockham; a Crane Co. brand.
2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 200 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See valve schedule articles.
7. Disc: Bronze.

B. Bronze, Swing Check Valves with Bronze Disc, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Stockham; a Crane Co. brand.
2. Standard: MSS SP-80, Type 3.
3. CWP Rating: 300 psig.
4. Body Design: Horizontal flow.
5. Body Material: ASTM B62, bronze.
6. Ends: Threaded or soldered. See valve schedule articles.
7. Disc: Bronze.

C. Bronze, Swing Check Valves, Press Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
- 2. Standard: MSS SP-80 and MSS SP-139.
 - 3. CWP Rating: Minimum 200 psig.
 - 4. Body Design: Horizontal flow.
 - 5. Body Material: ASTM B584, bronze.
 - 6. Ends: Press.
 - 7. Press Ends Connection Rating: Minimum 200 psig
 - 8. Disc: Brass or bronze.

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. Do not attempt to repair defective valves; replace with new valves.

3.2 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. Locate valves for easy access and provide separate support where necessary.
- 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. Check Valves: Install check valves for proper direction of flow.
 - 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.

- F. Install valve tags. Comply with requirements in Section 220500 "Common Work Requirements for Plumbing" for valve tags and schedules.

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. Use gate valves for shutoff service only.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze ball valves, two-piece with full port and bronze or brass trim. Provide with solder or press connection-joint ends.
 - 2. Bronze ball valves, three-piece with full port and bronze or brass trim.
 - 3. Bronze ball valves, two-piece with regular port and bronze trim may be used for drain valves.
 - 4. Check Valves:
 - a. Bronze swing check valves with bronze disc, Class 125, with soldered or threaded end connections.
 - b. Bronze swing check valves with press-end connections.

END OF SECTION 220523

SECTION 220710 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services and plumbing equipment that is not factory insulated:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.
- B. Related Sections:
 - 1. Section 221100 "Water Piping and Specialties" for insulation on water piping and valves.
 - 2. Section 221300 "Sanitary Waste and Vent Piping and Specialties" for insulation on sanitary piping and valves.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
 - 3. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
 - 8. Detail removable insulation at equipment connections.
 - 9. Detail field application for each equipment type.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220500 "Common Work Requirements for Plumbing."
- B. Coordinate clearance requirements with piping and equipment Installer for piping and equipment insulation application. Before preparing piping 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Owens Corning.
 - 2. Preformed Pipe Insulation, Type II, Class 1: Unfaced.
 - 3. Preformed Pipe Insulation, Type II, Class 2: With factory-applied ASJ jacket.
 - 4. Block Insulation: Type I.
 - 5. Special-Shaped Insulation: Type III.
 - 6. Board Insulation: Type IV.
 - 7. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
 - 8. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials and Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA.
 - b. Armacell LLC.
 - c. K-Flex USA.
- H. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.
 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411). Comply with ASTM C553, Type II, and ASTM C1290, Type I, unfaced. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
- J. Glass-Fiber, Pipe and Tank: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 850 deg F, in accordance with ASTM C411. Comply with ASTM C1393.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning.
 2. Semirigid board material with factory-applied jacket.

3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Foster Brand; H. B. Fuller.
 2. Adhesive: As recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.
 3. Verify adhesive complies with the testing and product 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."

2.4 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Mon-Eco Industries, Inc.
 - d. Owens Corning.
 2. Permanently flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 58 to plus 176 deg F.
 4. Color: White or gray.
 5. Verify sealant has a VOC content of 420 g/L or less.
 6. Verify sealant complies with the testing and product 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."
- C. FSK and Metal Jacket Flashing Sealants:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Mon-Eco Industries, Inc.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.
5. Verify sealant has a VOC content of 420 g/L or less.
6. Verify sealant complies with the testing and product 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."

2.5 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 C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
 5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.

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.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Industrial Adhesives and Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Knauf Insulation.
 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.

2.8 SECUREMENTS

- A. Bands:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. RPR Products, Inc.
 2. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal.
 3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire Products.
 - b. Johns Manville; a Berkshire Hathaway company.

c. RPR Products, Inc.

D. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding; 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.

2.9 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGuire Manufacturing.
 - b. Plumberex Specialty Products, Inc.
 - c. ProFlo; a Ferguson Enterprises, Inc. brand.
 - d. Truebro; IPS Corporation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances 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. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. 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 piping and equipment, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system and equipment, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) 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 storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- 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. 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 attached to structure with vapor-barrier mastic.
 3. Install insert materials and 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.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 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 tape, in accordance with 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.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. 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.

3.4 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 Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. 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.

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 below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is 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 of same material and thickness as that 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 of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.

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. 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. Install removable insulation covers at locations indicated. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Glass-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives in accordance with manufacturer's recommended coverage rates per unit area, for 100 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 as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.

- b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints and 16 inches o.c. in both directions.
 - d. Do not compress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins, and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 5. Secure each layer of insulation with stainless steel or aluminum bands. Select band material compatible with insulation materials.
 - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 - 7. Stagger joints between insulation layers at least 3 inches.
 - 8. Install insulation in removable and replaceable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 - 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 - 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

3.7 INSTALLATION OF CELLULAR-GLASS INSULATION

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 jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
- 4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

- 1. Install prefabricated 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 cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. 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.

3.8 INSTALLATION OF FIELD-APPLIED JACKETS

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 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.

C. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 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.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- 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.

3.10 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- F. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each type of equipment defined in the "Indoor Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- G. All insulation applications will be considered defective if they do not pass tests and inspections.
- H. Prepare test and inspection reports.

3.11 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. Underground piping.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation is the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - 2. NPS 1-1/4 and Larger: Insulation is the following:
 - a. Cellular Glass: 1-1/2 inches thick.
- B. Domestic Hot and Recirculated Hot Water, Temperatures Less Than 140 deg. F:
 - 1. NPS 1-1/4 and Smaller: Insulation is the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - 2. NPS 1-1/2 and Larger: Insulation is the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
- C. Domestic Hot and Recirculated Hot Water, Temperatures 140 deg. F:
 - 1. NPS 1-1/4 and Smaller: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
 - 2. NPS 1-1/2 and Larger: Insulation is the following:
 - a. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- D. Trap Primer and Indirect Waste Piping:
 - 1. All Pipe Sizes: Insulation is the following:
 - a. Flexible Elastomeric: 1/2 inch thick.

3.13 INDOOR EQUIPMENT INSULATION SCHEDULE

- A. Insulate indoor and outdoor equipment that is not factory insulated.
- B. Domestic water pump insulation is the following:
 - 1. Cellular Glass: 2 inches thick.
- C. Domestic hot-water pump insulation is the following:
 - 1. Cellular Glass: 2 inches thick.
- D. Domestic hot-water storage tank insulation is the following, of thickness to provide an R-value of 12.5:
 - 1. Cellular glass.

END OF SECTION 220710

SECTION 221110 - WATER PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Ductile-iron pipe and fittings.
3. Piping joining materials.
4. Encasement for piping.
5. Transition fittings.
6. Dielectric fittings.
7. Vacuum breakers.
8. Backflow preventers.
9. Water pressure-reducing valves.
10. Automatic water shutoff valve systems.
11. Balancing valves.
12. Temperature-actuated, water mixing valves.
13. Outlet boxes.
14. Hose stations.
15. Hose bibbs.
16. Wall hydrants.
17. Drain valves.
18. Water-hammer arresters.
19. Trap-seal primer device.
20. Trap-seal primer systems.
21. Flexible connectors.
22. Water meters.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper tube and fittings.
2. Copper tube and fittings.
3. Ductile-iron pipe and fittings.
4. Piping joining materials.
5. Encasement for piping.
6. Transition fittings.
7. Dielectric fittings.
8. Vacuum breakers.
9. Backflow preventers.
10. Water pressure-reducing valves.
11. Automatic water shutoff valve systems.
12. Balancing valves.

13. Temperature-actuated, water mixing valves.
14. Strainers for domestic water piping.
15. Outlet boxes.
16. Hose stations.
17. Hose bibbs.
18. Wall hydrants.
19. Drain valves.
20. Water-hammer arresters.
21. Trap-seal primer device.
22. Trap-seal primer systems.
23. Flexible connectors.

B. Related Requirements:

1. Section 220500 "Common Work Requirements for Plumbing" for thermometers, pressure gauges, and flow meters in domestic water piping.
2. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
3. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

- A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type L.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings. Do not use solder joints on pipe sizes greater than NPS 4.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Do not use solder joints on pipe sizes greater than NPS 4.
- F. Cast 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. Do not use solder joints on pipe sizes greater than NPS 4.
- G. Wrought Copper Unions: ASME B16.22. Do not use solder joints on pipe sizes greater than NPS 4.
- H. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. T-DRILL Industries Inc.
 - 2. Description: Tee formed in copper tube in accordance with ASTM F2014.
- I. Grooved, Mechanical-Joint, Copper Tube Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASC Engineered Solutions.
 - b. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - c. Victaulic Company.
 - 2. Source Limitations: Obtain grooved, mechanical-joint copper tube appurtenances from single manufacturer.
 - 3. Grooved-End, Copper Fittings: ASTM B75/B75M copper tube or ASTM B584 bronze castings.
 - 4. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting, fluoroelastomer-blend gasket, UL classified per

NSF 61 and NSF 372, and rated for minimum 180 deg F, for use with ferrous housing and steel bolts and nuts; 300 psig minimum CWP pressure rating.

J. Pressure-Seal-Joint Fittings, Copper or Bronze:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. NIBCO INC.
 - c. Viega LLC.
2. Source Limitations: Obtain pressure-seal-joint fittings, copper or bronze, from single manufacturer.
3. Housing: Copper.
4. O-Rings and Pipe Stops: EPDM.
5. Tools: Manufacturer's special tools.
6. Minimum 200 psig working-pressure rating at 250 deg F.

2.4 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, Class 56, cement lined, zinc-coated, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, zinc coated, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, zinc coated, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, Class 56, cement lined, zinc coated.
2. Push-on joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on Joint Fittings:

1. AWWA C110/A21.10, zinc coated, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

F. Compact-Pattern, Push-on Joint Fittings:

1. AWWA C153/A21.53, zinc coated, ductile iron.
2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51, Class 56, cement lined, zinc coated.

2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Couplings: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dresser Pipeline Solutions.
 - b. Jay R. Smith Mfg Co; a division of Morris Group International.
 - c. Smith-Blair, a Xylem brand.
2. Source Limitations: Obtain sleeve-type transition couplings from single manufacturer.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
2. Source Limitations: Obtain dielectric unions from single manufacturer.
3. Standard: ASSE 1079.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GF Piping Systems: Georg Fischer LLC.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
2. Source Limitations: Obtain dielectric flanges from single manufacturer.
3. Standard: ASSE 1079.
4. Factory-fabricated, bolted, companion-flange assembly.
5. Pressure Rating: 125 psig minimum at 180 deg F.
6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, LLC.
 - b. CALPICO, Inc.
 - c. GPT; a division of EnPRO Industries.
2. Source Limitations: Obtain dielectric-flange insulating kits from single manufacturer.
3. Nonconducting materials for field assembly of companion flanges.
4. Pressure Rating: 150 psig.
5. Gasket: Phenolic, Temperature Rating: 225 deg F.
6. Bolt Sleeves: Phenolic or polyethylene.
7. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. Victaulic Company.
2. Source Limitations: Obtain dielectric nipples from single manufacturer.
3. Standard: IAPMO PS 66.
4. Electroplated steel nipple complying with ASTM F1545.
5. Pressure Rating and Temperature: 300 psig at 225 deg F.
6. End Connections: Male threaded or grooved.
7. Lining: Inert and noncorrosive, propylene.

2.8 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.9 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

- b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 12 psig maximum, through middle third of flow range.
 - 5. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Dual-Check-Valve Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
 - 2. Standard: ASSE 1024.
 - 3. Operation: Continuous-pressure applications.
 - 4. Body: Bronze with union inlet.
- C. Hose-Connection Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Woodford Manufacturing Company.
 - d. Zurn Industries, LLC.
 - 2. Standard: ASSE 1052.
 - 3. Operation: Up to 10-foot head of water back pressure.
 - 4. Inlet Size: NPS 3/4.
 - 5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
 - 6. Capacity: At least 3-gpm flow.
- D. Supply In-Line Check Valves:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Delta Faucet Company.
 - b. Sloan Valve Company.
 - c. Symmons, Inc.
 - d. Zurn Industries, LLC.

2. Description: In-line check valves installed on cold and hot water supplies to fixtures to prevent the crossing of water on thermostatic mixing valves, or faucets without integral check stops.
3. Size: 3/8-inch female by 3/8-inch male.

E. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; A Watts Water Technologies Company.
 - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - c. WATTS; A Watts Water Technologies Company.
2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.10 AUTOMATIC WATER SHUTOFF VALVE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FloLogic, Inc.
2. Reliance Detection Technologies.
3. WaterCop.
4. WATTS; A Watts Water Technologies Company.

B. Shutoff Control Ball Valves and Actuators:

1. Control Valve: Two-piece, full-port brass ball valve, MSS SP-110.
 - a. End Connections: Threaded, female.
 - b. Fittings: One 3/8-by-1/2-inch male compression and one 3/8-by-1/2-inch female compression.
 - c. Seats: PTFE.
 - d. O-Rings: FKM.
 - e. Stem: Low-lead brass. Blowout proof.
 - f. CWP Rating: 600 psig.
2. Manual-override control turn-knob for emergency operation of valve.
3. Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, fails closed.
 - a. Power Supply: 120 V ac.
 - b. Manual Intervention: Allowed.
 - c. Position Indicator: Standard.
4. Actuator Enclosure: Suitable for ambient conditions encountered by application.
5. Wired Leak Detection System:

- a. Power Supply: Class II transformer with cord and plug, 120 V ac, UL listed.
- b. Power Cord Length: 12 feet.
- c. Control Panel: LED power and LED valves indicator.
- d. Alarms: Audible alarm, with external output.
- e. Output Contacts: Interface with home security or BAS, cellular text notification service, or auto dialer accessories.
- f. Wired Sensors:
 - 1) Quantity Per Receiver: One.
- g. Cable Length: 8 feet.
- h. Cable Adder: 10 feet in length.

C. Shutoff Control Butterfly Valve and Actuator:

- 1. Compliance: MSS SP-67.
- 2. Full-port, epoxy-coated, ductile-iron lug body.
- 3. Seat: EPDM, minus 30 deg F to plus 250 deg F.
- 4. Face-to-Face Flange: ASME B16.5 flanges.
- 5. Disc Design: Floating stainless steel dual shaft.
- 6. Disc Material: Coated ductile iron.
- 7. Locating Pin: Carbon steel.
- 8. Bushings: PTFE.
- 9. O-Rings: EPDM.
- 10. Ten-position stop.
- 11. Manual-override control turn-knob for emergency operation of valve.
- 12. Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, fails closed.
 - a. Power Supply: 120 V ac.
 - b. Manual Intervention: Allowed.
 - c. Position Indicator: Standard.
- 13. Actuator Enclosure: Suitable for ambient conditions encountered by application.
- 14. Wired Leak Detection System:
 - a. Power Supply: Class II transformer with cord and plug, 120 V ac, UL listed.
 - b. Power Cord Length: 12 feet.
 - c. Control Panel: LED power and LED valves indicator.
 - d. Alarms: Audible alarm, with external output.
 - e. Output Contacts: Interface with home security or BAS, cellular text notification service, or auto dialer accessories.
 - f. Wired Sensors:
 - 1) Quantity Per Receiver: One.
 - g. Cable Length: 25 feet.
 - h. Cable Adder: 25 feet in length.

D. Clothes Washer Shutoff Control Valve and Actuator:

1. Brass or stainless steel ball valve.
2. End Connections: Male hose connections, NPS 3/4.
3. Pressure Rating: 400 psi at 32 to 150 deg F.
4. Valve Actuator:
 - a. Enclosure: Suitable for ambient conditions encountered by application.
 - b. Power Supply: 120 V ac.
 - c. Position Indicator: Standard.
5. Wired Leak Detection System:
 - a. Water sensor with minimum 6-foot length of wire.
 - b. 120 V ac step-down transformer with cord and plug.
 - c. LED operation and leak notification.
 - d. Audible alarm.
 - e. Power failure or manual disconnection of power causes valves to close.

E. Accessories:

1. Electrical Plug Interrupter: Plugs into standard 120 V ac wall outlet.
2. Gas Flow Interrupter: ECO connector with female spade connectors. Factory prewired, 8 feet.
3. Gas Interface Cable: Interface cable with male and female connectors.
4. Step-Down Transformer: 120 V ac to 24 V ac with mounting plate, 12-foot plenum wire to power, and 8-foot plenum wire to sensor.
5. Liquid Level Sensors: Monitor fluid levels in addition to detecting plumbing leaks.
6. Auto Dialer: Send and receive automatic alerts when a fault condition occurs. Standard output contacts trigger up to nine predetermined telephone number calls.
 - a. Prerecord message for future playback.
 - b. 10-second recordable message.
 - c. Built-in tamper switch.
 - d. DC adaptor with battery backup.
 - e. Programmable as a silent (dialer only) or audible (siren and dialer) alarm.
 - f. Easy "Stop Call Sequence" - push "#" on phone to acknowledge the alarm and stop the dialing sequence.

2.11 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bell & Gossett; a Xylem brand.
 - b. NIBCO INC.
 - c. WATTS; A Watts Water Technologies Company.
2. Type: Ball valve with two readout ports and memory-setting indicator.
3. Body: Brass.

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. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass or stainless steel.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

C. Automatic Flow Control Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Caleffi North America.
 - b. IMI Hydronic Engineering Inc.
 - c. ThermOmegaTech.
2. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
3. Pressure Rating: 200 psig.
4. Size: NPS 2 or smaller.
5. Body: Stainless steel or brass.
6. Flow Cartridge: Stainless steel or antiscaling polymer.
7. End Connections: Threaded or solder joint.
8. Accessories: Integral check valve, thermometer and thermowell.

2.12 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. POWERS; A WATTS Brand.
 - b. Symmons Industries, Inc.
 - c. WATTS; A Watts Water Technologies Company.

2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Rough bronze.

B. Primary, Electronic, Water Mixing Valve Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Caleffi North America.
 - b. Leonard Valve Company.
 - c. POWERS; A WATTS Brand.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed, electronically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or solder joint inlets and outlet.
7. Accessories: Manual temperature override control, check stops on hot- and cold-water supplies, and automatic hot- and cold-water shutoff upon inlet supply failure.
8. Tempered-Water Setting: 125 deg F.
9. Valve Finish: Bronze.
10. Digital temperature control and monitoring module.
 - a. Controls temperature within plus or minus 2 deg F.
 - b. User programmable at module or through BAS.
 - c. ASHRAE 188 compliance.
 - d. Local and remote monitoring.
 - e. BACNet protocol language(s).
 - f. 115 V ac, 60 Hz.
 - g. Battery backup.

C. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Caleffi North America.
 - b. Lawler Manufacturing Company, Inc.
 - c. POWERS; A WATTS Brand.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.

7. Finish: Chrome plated.
8. Tempered-Water Setting: 125 deg F.

2.13 STRAINERS

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Titan Flow Control, Inc.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.

2.14 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; a Division of Morris Group International.
 - b. Oatey Co.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Symmons Industries, Inc.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Drain Outlet Connection: NPS 2.
6. Accessory: Water hammer arresters.
7. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
8. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
9. Inlet Hoses: Two 60-inch-long, braided stainless steel, household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
10. Drain Hose: One 48-inch-long, rubber, household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Oatey Co.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Water-Tite, IPS Corporation.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Accessory: Water hammer arrestor.
6. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.15 HOSE BIBBS

A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.16 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Woodford Manufacturing Company.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.

2.17 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.18 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. ProFlo; a Ferguson Enterprises, Inc. brand.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. WATTS; A Watts Water Technologies Company.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.19 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. Precision Plumbing Products.
 - c. ProFlo; a Ferguson Enterprises, Inc. brand.
 - d. WATTS; A Watts Water Technologies Company.
 - e. Wade Drains USA.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.20 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Plumbing Products.
 - b. Sioux Chief Manufacturing Company, Inc.
 - c. Zurn Industries, LLC.
 - d. Wade
2. Standard: ASSE 1044.
3. Inlet Size: NPS 3/4, ASTM B88, Type L; copper, water tubing.
4. Cabinet: Surface-mounted steel box with stainless steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120 V ac power.
 - 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.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Four.
8. Size Outlets: NPS 1/2.

2.21 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Mason Industries, Inc.
 - 3. Metraflex Company (The).
- B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger is to be the following:
 - 1. Annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
 - 3. Push-on joint, ductile-iron pipe; standard-pattern, push-on joint fittings; and gasketed joints.
 - 4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- E. Under-building-slab, trap primer and domestic water piping, NPS 1 and smaller is to be the following:
 - 1. Soft copper tube, ASTM B88, Type K; continuous, with no buried joints.
- F. Aboveground domestic water piping, NPS 2 and smaller is to be the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 is to be the following:

1. Drawn-temper copper tube, ASTM B88, Type L; copper, solder-joint fittings; and soldered joints.

3.2 EARTHWORK

A. Comply with requirements in Division 31 for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

- 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 in accordance with CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.
- D. Install valves in accordance with the following:
1. Section 220523 "General Duty Valves for Plumbing Piping."
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in this Section.
- F. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. 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.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.

- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install pressure gauges on suction and discharge piping for each plumbing pump. Comply with requirements for pressure gauges in Section 220500 "Common Work Requirements for Plumbing."
- P. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic Water Pumps."
- Q. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220500 "Common Work Requirements for Plumbing."
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220500 "Common Work Requirements for Plumbing."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Requirements for Plumbing."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220500 "Common Work Requirements for Plumbing."

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel 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 in accordance with 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.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

- F. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- G. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- H. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints in accordance with AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- I. 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 in accordance with ASME B31.9.
- J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 220500 "Common Work Requirements for Plumbing."
- B. Install hangers for copper or ductile iron pipe, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper or ductile iron pipe to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install 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.
 - 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, fixed air-gap fitting, or equivalent positive pipe separation 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 unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- C. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- D. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.

- E. Flood Protection Shut Down Valves: Install flood protection shut down valves upstream of reduced-pressure-principle backflow preventers. Install valve in horizontal position and in accordance with the manufacturer's instructions. Install the flood sensor in the backflow preventer discharge piping.
- F. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- G. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- H. Y-Pattern Strainers: For water, install on supply side of each control valve, solenoid valve and pump.
- I. Supply In-Line Check Valves: Install in-line checks on hot and cold water fixture supplies unless the faucet has integral checks.
- J. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 1-1/2-by-3-1/2-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Division 06.
- K. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- L. Supply-Type, Trap-Seal Primer Device: Install 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.
- M. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- N. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.10 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Division 26.
- B. Ground equipment in accordance with Division 26.
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.11 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Division 26.

3.12 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220500 "Common Work Requirements for Plumbing."
- B. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Backflow preventers.
 - 2. Water pressure-reducing valves.
 - 3. Automatic water shutoff valve systems.
 - 4. Temperature-actuated, water mixing valves.
 - 5. Trap-seal primer systems.
 - 6. Water meters.
- C. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220500 "Common Work Requirements for Plumbing."

3.13 CLEANING

- A. Clean and disinfect 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 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 in accordance with 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. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- 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. 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.

3.14 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.
- B. Set field-adjustable pressure set points of water pressure-reducing valves.
- C. Set field-adjustable flow set points of balancing valves.
- D. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

3.15 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day 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 installation and before setting fixtures.

- 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. 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.
 - c. 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.
 - d. 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 it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
 - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - g. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- D. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- E. Perform the following tests and inspections.
 1. Test each pressure vacuum breaker and reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

- G. Prepare test and inspection reports.

END OF SECTION 221110

SECTION 221123.21 - INLINE, DOMESTIC-WATER 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.

1.2 SUMMARY

- A. Section Includes:
 - 1. In-line, sealless centrifugal pumps.
- B. Related Requirements:
 - 1. Section 221123.13 "Domestic-Water Packaged Booster Pumps" for booster systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which pumps will be attached.
 - 2. Size and location of initial access modules for acoustical tile.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written instructions for handling.

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. UL Compliance: UL 778 for motor-operated water pumps.
- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

2.2 HOT WATER CIRCULATOR PUMPS

- A. Description: Wet rotor type stainless-steel, variable speed, in-line, NSF/ANSI 61 certified circulator pump, with integrated motor/VFD, built-in sensor, and constant temperature programming for domestic hot water re-circulation.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grundfos Pumps Corporation.
 - 2. Taco Comfort Solutions.
- C. Basis of Design: Grundfos Magna3.
- D. Capacities and Characteristics: Refer to schedule on drawings.
- E. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Minimum Working Pressure: 125 psig.
 - 3. Maximum Continuous Operating Temperature: 220 deg F.
 - 4. Casing: Cast iron, with threaded or companion-flange connections.
 - 5. Impeller: Stainless steel.
 - 6. Motor: Variable speed.

- F. Warranty: Non-prorated period of 24 months from date of installation, not to exceed 30 months from date of manufacture. Warranty shall cover pump, motor and terminal box as a complete unit.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220500 "Common Work Requirements for Plumbing."
 - 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.

2.4 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
 - 1. Type: Water-immersion temperature sensor, for installation in piping.
 - 2. Range: 65 to 200 deg F.
 - 3. Enclosure: NEMA 250..
 - 4. Operation of Pump: On or off.
 - 5. Transformer: Provide if required.
 - 6. Power Requirement: 120 V ac.
 - 7. Settings: Start pump at 115 deg F and stop pump at 125 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

3.2 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
- D. Install thermostats in hot-water return piping.

3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221100 "Water Piping and Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Connect domestic-water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
- D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for strainers specified in Section 221100 "Water Piping and Specialties." Comply with requirements for valves specified in Section 220523 "General Duty Valves for Plumbing Piping."
 - 1. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge tapings where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220500 "Common Work Requirements for Plumbing."
- E. Install bypass piping with normally-closed shutoff valve. Bypass piping shall connect ahead of valves on the suction piping, and after the valves on the discharge piping. Bypass piping shall be same size as suction and discharge piping.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring between temperature controllers and devices.
- C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220500 "Common Work Requirements for Plumbing" for identification of pumps.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 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.
- F. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

3.7 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.
 - 2. Check piping connections for tightness.
 - 3. Clean strainers on suction piping.
 - 4. Set thermostats, for automatic starting and stopping operation of pumps.
 - 5. 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.
 - c. Verify that pump is rotating in the correct direction.
 - 6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - 7. Start motor.
 - 8. Open discharge valve slowly.
 - 9. Adjust temperature settings on thermostats.
 - 10. Adjust timer settings.

3.8 ADJUSTING

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature set points.
 - 1. Set pumps to start when temperature reaches 5 deg. F below hot water setpoint.
 - 2. Set pumps to stop at 130 deg. F.

- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION 221123.21

SECTION 221300 - SANITARY WASTE AND VENT PIPING AND 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. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Galvanized-steel pipe and fittings.
4. Ductile-iron pipe and fittings.
5. Copper tube and fittings.
6. Specialty pipe fittings.
7. Encasement for underground metal piping.
8. Backwater valves.
9. Cleanouts.
10. Miscellaneous sanitary drainage piping specialties.
11. Floor drains.
12. PVC pipe and fittings.

- B. Related Requirements:

1. Division 07 for metal roof flashing assemblies.
2. Division 07 for preformed flashings.
3. Division 07 for through-penetration firestop assemblies.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data

1. Hub-and-spigot, cast-iron soil pipe and fittings.
2. Hubless, cast-iron soil pipe and fittings.
3. Galvanized-steel pipe and fittings.
4. Ductile-iron pipe and fittings.
5. Copper tube and fittings.
6. Backwater valves.
7. Cleanouts.
8. Miscellaneous sanitary drainage piping specialties.
9. Floor drains.
10. Specialty pipe fittings.
11. PVC pipe and fittings.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings:

1. For hubless, single-stack drainage system, include plans, elevations, sections, and details. Submit to manufacturer's product representative for review and approval.
2. Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Field quality-control reports.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

1.8 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10 ft. head of water.

2.2 PIPING MATERIALS AND DRAIN ASSEMBLIES

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- C. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- D. 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.

2.3 PVC PIPE AND FITTINGS

- A. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- C. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.
- D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
- F. Solvent Cement: ASTM D2564.

2.4 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AB & I Foundry; a part of the McWane family of companies.
 - 2. Charlotte Pipe and Foundry Company.
 - 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - 2. ASTM A74, service cast iron.
- C. Gaskets: ASTM C564, rubber.
- D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.5 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AB & I Foundry; a part of the McWane family of companies.
 - 2. Charlotte Pipe and Foundry Company.
 - 3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - 2. ASTM A888 or CISPI 301.
- C. Single-Stack Aerator Fittings: ASME B16.45, hubless, cast-iron aerator and deaerator drainage fittings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conine Manufacturing Co., Inc.
 - b. SE Sovent.
- D. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Ideal Tridon Group.
 - d. Mission Rubber Company, LLC; a division of MCP Industries.
 - e. Tyler Pipe; a subsidiary of McWane Inc.

2. Standards: ASTM C1277 and CISPI 310.
3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

E. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Ideal Tridon Group.
 - d. Mission Rubber Company, LLC; a division of MCP Industries.
 - e. Tyler Pipe; a subsidiary of McWane Inc.
2. Standards: ASTM C1277 and ASTM C1540.
3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.6 DUCTILE-IRON PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company.
2. McWane Ductile.
3. U.S. Pipe, a Forterra company.

B. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot ends unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Ductile-Iron, Push-on-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with push-on-joint bell and plain spigot ends unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, push-on-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Gaskets: AWWA C111/A21.11, rubber.

D. Ductile-Iron, Grooved-Joint Piping: AWWA C151/A21.51, with round-cut-grooved ends in accordance with AWWA C606.

E. Ductile-Iron, Grooved-End Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. Smith-Cooper International.
 - c. Victaulic Company.
2. Grooved-End, Ductile-Iron Fittings: ASTM A536, ductile-iron castings, with dimensions matching AWWA C110/A 21.10, ductile-iron pipe or AWWA C153/A 21.53, ductile-iron fittings, and complying with AWWA C606 for grooved ends.
3. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F1476, Type I. Include ferrous housing sections with continuous curved keys, EPDM-rubber center-leg gasket suitable for hot and cold water, and bolts and nuts.

2.7 COPPER TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Cerro Flow Products, LLC.
 2. Great Lakes Copper Ltd.
 3. Mueller Streamline Co.
- B. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
- C. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- D. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.
- E. Soft Copper Tube: ASTM B88, Type L, water tube, annealed temper.
- F. Copper Pressure Fittings:
 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- G. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- H. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.8 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
 - e. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
 - 2) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
5. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) EBAA Iron Sales, Inc.
 - 2) Ford Meter Box Company, Inc. (The).
 - 3) JCM Industries, Inc.
 - b. Standard: AWWA C219.

- c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
- d. Gasket Material: Natural or synthetic rubber.
- e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

- 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- 2. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) A.Y. McDonald Mfg. Co.
 - 2) WATTS; A Watts Water Technologies Company.
 - 3) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
- 3. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) GF Piping Systems: Georg Fischer LLC.
 - 2) WATTS; A Watts Water Technologies Company.
 - 3) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- 4. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advance Products & Systems, LLC.
 - 2) GF Piping Systems: Georg Fischer LLC.
 - 3) GPT; a division of EnPRO Industries.

b. Description:

- 1) Nonconducting materials for field assembly of companion flanges.
- 2) Pressure Rating: 150 psig.
- 3) Gasket: Neoprene or phenolic.
- 4) Bolt Sleeves: Phenolic or polyethylene.
- 5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
- 2) Matco-Norca.
- 3) Precision Plumbing Products.

b. Description:

- 1) Standard: IAPMO PS 66.
- 2) Electroplated steel nipple.
- 3) Pressure Rating: 300 psig at 225 deg F.
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.9 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted access check valve.
6. End Connections: Hub and spigot.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
8. Extension: ASTM A74, Service Class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

2.10 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk, plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top-Loading Classification: Heavy Duty.
13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

2.11 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, 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 C564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Floor-Drain, Inline Trap Seal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Green Drain, Inc.
 - b. ProVent Systems.
 - c. RectorSeal Plumbing; A CSW Industrials Company.
2. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
3. Material: Polymer.
4. Standard: Tested and certified in accordance with ASSE 1072.
5. Listing: IAPMO listed.
6. Size: Same as floor drain outlet or strainer throat.

D. 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.

E. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

F. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.12 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Wade; a subsidiary of McWane Inc.

- d. Zurn Industries, LLC.
 - 2. Standard: ASME A112.6.3.
 - 3. Pattern: Floor drain.
 - 4. Body Material: Gray iron.
 - 5. Seepage Flange: Required.
 - 6. Anchor Flange: Required.
 - 7. Clamping Device: Required.
 - 8. Outlet: Bottom.
 - 9. Backwater Valve: Not required.
 - 10. Coating on Interior and Exposed Exterior Surfaces: Not required.
 - 11. Top or Strainer Material: Nickel bronze.
 - 12. Top of Body and Strainer Finish: Nickel bronze.
 - 13. Top Shape: Round.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. 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.
 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 3. Do not change direction of flow more than 90 degrees.
 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 3. Maintain swab in piping and pull past each joint as completed.
 4. Buried Piping Under Structural Slabs: Install piping with stainless steel hangers, rods and attachments to support buried piping under structural slabs, independent of soil and bedding.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- N. Install steel piping in accordance with applicable plumbing code.
- O. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- P. Install engineered soil and waste and vent piping systems as follows:
1. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for sleeves specified in Section 220500 "Common Work Requirements for Plumbing."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
 1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Requirements for Plumbing."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Requirements for Plumbing."
- U. Install aboveground ABS piping in accordance with ASTM D2661.

3.2 JOINT CONSTRUCTION

- A. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
- B. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- C. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- D. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- E. Hubless, Cast-Iron Soil Piping Coupled Joints:
 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- F. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
 1. Cut threads full and clean using sharp dies.
 2. 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.
 - c. Do not use pipe sections that have cracked or open welds.
- G. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

- H. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- I. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- J. Joint Restraints and Sway Bracing:
 - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.3 INSTALLATION OF SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.
 - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
 - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

3.4 INSTALLATION OF SPECIALTIES

- A. Install backwater valves in building drain piping.
 - 1. 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 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- H. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- I. Install vent caps on each vent pipe passing through roof.
- J. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- L. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- M. Install wood-blocking reinforcement for wall-mounting-type specialties.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- 3.5 INSTALLATION OF DRAINS
- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Set with grates depressed according to the following drainage area radii:

- a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
6. Install floor sinks near the equipment it serves and away from walking paths to avoid a tripping hazards.
- B. Install trench drains at low points of surface areas to be drained.
 1. Set grates of drains flush with finished surface, unless otherwise indicated.
- C. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.
 1. Install on support devices, so that top will be flush with adjacent surface.

3.6 INSTALLATION OF VALVES

- A. General valve installation requirements for general-duty valve installation are specified in Sections 220523 "General Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
 1. Install shutoff valve on each sewage pump discharge.
 2. Install full-port ball valve for piping NPS 2 and smaller.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 1. Horizontal Piping: Horizontal backwater valves.
 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220500 "Common Work Requirements for Plumbing".
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.

5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Buried Piping Under Structural Slabs: Install piping with stainless steel hangers, rods and attachments to support buried piping under structural slabs, independent of soil and bedding.
- C. Install hangers for cast-iron and steel soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping and tubing within 12 inches of each fitting[, **valve,**] and coupling.
- E. Support vertical runs of cast-iron and steel soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- G. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- H. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves with cleanout cover flush with floor.

6. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with 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.
- F. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

3.9 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220500 "Common Work Requirements for Plumbing."
- C. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220500 "Common Work Requirements for Plumbing."

3.10 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 waste and vent piping in accordance with 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.

- a. 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 waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. 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.
 - a. 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.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. 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.

3.11 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- D. Place plugs in ends of uncompleted piping at end of day and when work stops.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.
- F. Exposed Plastic Piping: Protect PVC plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.12 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller are to be the following:
 - 1. Solid-wall or cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 2. Service cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 3. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, vent piping NPS 3 and smaller is to be the following:
 - 1. Solid-wall or cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 2. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 3. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90): Hard copper tube, Type M; copper pressure fittings; and soldered joints.
 - 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller are to be the following:
 - 1. Solid-wall or cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 2. Service cast-iron soil piping; gaskets; and gasketed joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221300

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Commercial, light-duty, storage, electric, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Commercial, light-duty, storage, electric, domestic-water heaters.
 - 2. Domestic-water heater accessories.
- B. Product Data Submittals: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Sustainable Design Submittals:
 - 1. Water Heaters: Product Data for water heater compliance with ASHRAE's "Advanced Energy Design Guides."
- D. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.
- B. Product Certificates: For each type of commercial, electric, domestic-water heater.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.5 COORDINATION

- A. Coordinate sizes and locations of concrete bases or stands with actual equipment provided.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-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 Periods: From date of Substantial Completion.
 - a. Commercial, Light-Duty, Storage, Electric, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Three years.
 - b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: 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.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A. O. Smith Corporation.
 - b. Bradford White Corporation.
 - c. HTP; a Ariston Thermo USA LLC Brand.
 - d. Lochinvar, LLC.
 - e. PVI; A WATTS Brand.
 - f. Rheem Manufacturing Company.
 - g. State Industries.
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: UL 1453.
4. Storage-Tank Construction: ASME-code, steel vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - c. Insulation: Comply with ASHRAE/IES 90.1.
 - d. Jacket: Steel with enameled finish or high-impact composite material.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.
6. Special Requirements: NSF 5 construction.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. ProFlo; a Ferguson Enterprises, Inc. brand.
 - c. Taco Comfort Solutions.
2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. 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.
4. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
5. Capacity and Characteristics:
 - a. Working-Pressure Rating: 100 psig.
 - b. Capacity Acceptable: 10 gal. minimum.

B. Drain Pans: Corrosion-resistant metal with 2 inch minimum raised edge. Include dimensions not less than 2 inches greater than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.

D. Heat-Trap Fittings: ASHRAE/IES 90.1.

E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.

F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

- I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- J. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Division 03.
 - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. 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 concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General Duty Valves for Plumbing Piping."
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-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.

- D. Install combination temperature-and pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-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.
- E. 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 electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221100 "Water Piping and Specialties."
- F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Requirements for Plumbing."
- G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- H. Fill electric, domestic-water heaters with water.
- I. Charge domestic-water expansion tanks with air to required system pressure.
- J. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water to contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221100 "Water Piping and Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220500 "Common Work Requirements for Plumbing."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency:
 - 1. Owner will engage a qualified testing agency to perform tests and inspections.
 - 2. Engage a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters. Training to be a minimum of one hour.

END OF SECTION 223300

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Eye/face wash equipment.
 - 2. Supplemental equipment.
 - 3. Water-tempering equipment.

1.2 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Tepid: Between 60 and 90 deg F.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Plans, elevations, sections, and mounting details.
 - 2. Details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 4. Diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Submittals:
 - 1. Field quality-control reports.
- B. Emergency fixture third-party certification documentation.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For emergency plumbing fixtures.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ANSI/ISEA Z358.1 for emergency plumbing fixtures including third-party certification of fixtures.
- B. Comply with ASSE 1071 for temperature-actuated mixing valves for plumbed emergency fixtures.
- C. Comply with ASME A112.18.1/CSA B125.1 for water-supply fittings.
- D. Comply with ASME A112.18.2/CSA B125.2 for plumbing waste fittings.
- E. Comply with NSF 61 and NSF 372 for fixture materials that will be in contact with potable water.
- F. 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.

2.2 EYE/FACE WASH EQUIPMENT

- A. Eye/Face Wash Units - Deck Mounted, Plumbed: :
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Guardian Equipment Co.
 - c. WaterSaver Faucet Co.
 - 2. Source Limitations: Obtain eye/face wash units, deck mounted, plumbed, from single manufacturer.
 - 3. Capacity: Not less than 3 gpm for at least 15 minutes.
 - 4. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
 - 5. Control-Valve Actuator: Paddle.
 - 6. Spray-Head Assembly: Two or four spray heads.
 - 7. Receptor: Chrome-plated brass or stainless steel bowl.
 - 8. Drain Piping:
 - a. Size: NPS 1-1/4 minimum.
 - 9. Mounting: Deck.
 - 10. Accessories:

- a. Electric alarm with flashing light and horn.
- b. Thermostatic mixing valve assembly including ball valve shutoffs and outlet temperature gauge.
- c. Flow switch; single pole.
- d. Dust covers.
- e. Magnetically actuated proximity switch.
- f. Scald protection valve.

2.3 WATER-TEMPERING EQUIPMENT

A. Water-Tempering Equipment - Hot and Cold Water: .

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.
 - b. Guardian Equipment Co.
 - c. Haws Corporation.
 - d. Lawler Manufacturing Company, Inc.
 - e. Speakman Company.
 - f. WATTS; A Watts Water Technologies Company.
 - g. WaterSaver Faucet Co.
- 2. Source Limitations: Obtain water-tempering equipment, hot and cold water, from single manufacturer.
- 3. Description: Factory-fabricated equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide 70 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.
 - b. Supply Connections: For hot and cold water.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EMERGENCY PLUMBING FIXTURE

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.

- C. Fasten fixtures to substrate.
- D. Locate emergency showers, combination units and close to main door of the , but no greater than 50 feet from the hazard area.
- E. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of equipment. Use ball valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 220523 "General Duty Valves for Plumbing Piping."
 - 1. Exceptions:
 - a. Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
 - b. Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- F. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221100 "Water Piping and Specialties."
- G. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 220500 "Common Work Requirements for Plumbing."
- H. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 221300 "Sanitary Waste and Vent Piping and Specialties."
- I. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 221300 "Sanitary Waste and Vent Piping and Specialties."
- J. For pedestal mounted emergency fixtures, modify the drain outlet to be located in the front or side of the unit mounted at 18 inches minimum above the finish floor. Provide a nipple and 90 degree elbow to discharge the waste into a bucket during testing.
- K. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220500 "Common Work Requirements for Plumbing."

3.3 PIPING CONNECTIONS

- A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221100 "Water Piping and Specialties."
- B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with

requirements for hot- and cold-water piping specified in Section 221100 "Water Piping and Specialties."

- C. Connect cold water and electrical power to electric heating water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221100 "Water Piping and Specialties."
- D. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 221300 "Sanitary Waste and Vent Piping and Specialties."
- E. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.
- F. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.
- G. The water-tempering equipment shall be sized for two emergency showers running simultaneously.
- H. The tempered water piping shall be run in a continuous loop to supply all emergency plumbing equipment. Uncirculated branch piping to an emergency plumbing fixture shall not exceed 15 feet.

3.4 IDENTIFICATION

- A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 220500 "Common Work Requirements for Plumbing."

3.5 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Operate and adjust emergency plumbing fixtures and controls. Replace damaged and malfunctioning fixtures and controls.
- B. Adjust or replace fixture flow regulators for proper flow.
- C. Adjust equipment temperature settings.

3.7 CLEANING AND PROTECTION

- A. Clean emergency plumbing fixtures with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed emergency plumbing fixtures and fittings.
- C. Do not allow use of emergency plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224500

SECTION 230500 - BASIC MECHANICAL REQUIREMENTS

TABLE OF CONTENTS

PART 1 - GENERAL	1
1.1 SUMMARY	1
1.2 REFERENCES	2
1.3 DEFINITIONS	3
1.4 SUBMITTALS	5
1.5 QUALITY ASSURANCE	9
1.6 DELIVERY, STORAGE, AND HANDLING	10
1.7 PROJECT CONDITIONS	11
1.8 COORDINATION DRAWINGS	11
1.9 WARRANTY	14
1.10 MANUALS AND INSTRUCTIONS	14
1.11 RECORD DOCUMENTS	17
1.12 ELECTRONIC DRAWING FILES	17
PART 2 - PRODUCTS	18
2.1 ELECTRICAL EQUIPMENT LISTINGS AND APPROVALS	18
2.2 SLEEVES AND PENETRATIONS	18
2.3 VALVE TAGS & VALVE TAG CHARTS	20
2.4 IDENTIFICATION OF PIPING, DUCTWORK AND EQUIPMENT	21
2.5 PRESSURE VESSELS	23
2.6 MASTICS, ADHESIVES, SEALANTS AND TAPES	23
PART 3 - EXECUTION	23
3.1 EXAMINATION	23
3.2 PREPARATION	24
3.3 SYSTEM SHUTDOWNS	24
3.4 LIFE SAFETY SYSTEMS SHUTDOWNS	24
3.5 DEMOLITION WORK	24
3.6 CORE DRILLING	25
3.7 CUTTING AND PATCHING	25
3.8 SLEEVES AND PENETRATIONS	25
3.9 GENERAL INSTALLATION REQUIREMENTS	26
3.10 ACCESS PANELS	28
3.11 VALVE TAG CHARTS	29
3.12 IDENTIFICATION OF PIPING, DUCTWORK AND EQUIPMENT	29
3.13 FIRE WATCH	30
3.14 SCAFFOLDING, HOISTING, RIGGING AND STAGING	30
3.15 RECORD DOCUMENTS	30
3.16 SYSTEM START-UPS AND INSTRUCTIONS	31
3.17 CONSTRUCTION CERTIFICATIONS AND AFFIDAVITS	31
3.18 OEM CONTROLS INTEGRATION	32

SECTION 23 05 00 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of Division 23 is governed by the General and Supplementary Conditions of the Contract, and Sections of Division 1 of the Project Manual.
- B. Perform work and provide materials and equipment as shown on Drawings and as specified or referenced in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide complete and fully functional systems installation.
- C. Give notices, file plans, obtain permits and licenses, pay fees and backcharges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with the Contract Documents.
- D. Section Includes: The work of this Section includes the basic requirements common to the Sections of Division 23, including:
 - 1. Demolition of existing HVAC equipment, ductwork, piping, automatic temperature controls and appurtenances.
 - 2. Definitions,
 - 3. Organization of submittals,
 - 4. Proposed substitutions,
 - 5. Core drilling,
 - 6. Cutting and Patching,
 - 7. Sleeves and penetrations,
 - 8. Coordination drawings,
 - 9. Valve tags,
 - 10. Equipment and piping identification,
 - 11. Record documents,
 - 12. Systems start-ups,
 - 13. Access Panels,
 - 14. Fire Watch,
 - 15. Scaffolding, hoisting, rigging and staging,
 - 16. Commissioning.

- E. Related Sections: Related work specified in other Sections includes, but is not necessarily limited to:
1. Cutting and Patching: Openings in masonry, concrete, tile, and other parts of structure, except drilling for hangers, providing holes and openings in metal decks, and core drilling.
 2. Temporary Facilities and Controls: Temporary heat, light, power, fire protection, and sanitary facilities for use during construction.
 3. Selective Demolition: Removal and disposal of demolished mechanical and electrical piping and conduit systems and equipment.
 4. Excavation and Backfilling: Trench excavation, pipe bedding, and backfilling.
 5. Concrete: Housekeeping pads and inertia pads.
 6. Metal Fabrications: Structural supports necessary to distribute loading from equipment to roof, floor, walls or other building structural components.
 7. Firestops and Smoke seals: Caulking of pipe and duct penetrations through floor slabs and fire-rated or smoke partitions.
 8. Membrane Roofing System: Flashing of roof penetrations and roof drains.
 9. Flashing and Sheet Metal.
 10. Sealants and Caulking: Sealing joints between plumbing fixtures and abutting surfaces.
 11. Access Panels: Access to concealed mechanical, electrical, and telecommunications devices.
 12. Existing Ceilings: Removal of existing ceilings for new work under Divisions 20 through 26.
 13. Painting: Painting of exposed piping and equipment except as specified in this Section.
 14. Electrical Power: Power for mechanical equipment as specified in Division 26.

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
1. ANSI A13.1 - Scheme for the Identification of piping systems.
- B. American Society for Testing and Materials (ASTM)
1. ASTM E119 - Test Methods for Fire Tests of Building Construction and Materials.
 2. ASTM E814 - Test Method for Fire Tests of Through-Penetration Fire Stops.

- C. Compressed Gas Association (CGA)
 - 1. C-9 - Standard Color Marking of Compressed Gas Cylinders Intended for Medical Use.
- D. Construction Specifications Institute. (CSI)
 - 1. Manual of Practice
- E. Underwriters Laboratories (UL)
 - 1. Fire Resistance Directory, Vol. I - Beams, Columns, Floors, Roofs, Walls, and Partitions.
 - 2. Fire Resistance Directory, Vol. II, Through Penetration Firestop Systems.
 - 3. ANSI/UL1479 - Fire Tests of Through Penetration Firestops.
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
 - 1. Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.
- G. National Fire Protection Association
 - 1. No. 70 – National Electrical Code.
 - 2. No. 70E – Standard for Electrical Safety Requirements for Employee Workplaces.
 - 3. No. 72 – National Fire Alarm Code.
 - 4. No. 241 - Safeguarding Construction, Alteration, and Demolition Operations.
- H. International Code Council (ICC):
 - 1. International Building Code – IBC.
 - 2. International Plumbing Code – IPC.
 - 3. International Mechanical Code – IMC.
 - 4. International Fire Prevention Code – IFPC.
- I. South Coast Air Quality Management District
 - 1. Rule #1168 VOC Limits.

1.3 DEFINITIONS

- A. General: Words and terminology used throughout the of Sections of Division 23 shall be understood in their common usage as defined in a common dictionary, and as further defined in the CSI Manual of Practice, the General and Supplementary Conditions of the Contract, Division 1 of the Project Manual, and the Sections of Division 23.
- B. Specification Content: Sections of Division 23 may use certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 - 1. Abbreviated Language: Language used in Specifications and other Contract Documents maybe of the abbreviated style. Words and meanings shall be interpreted as appropriate. Words implied, but not stated shall be interpolated as

the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Streamlined Language: The Specifications generally use the imperative mood and streamlined language. Requirements expressed in the imperative mood shall be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.
 - a. The words "shall be" are implied where a colon (:) is used within a sentence or phrase.
- C. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, or other paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the reader locate the reference. Location is not limited.
- D. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases.
- E. Approved: When used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, The term "approved," is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.
- F. Furnish: Furnish means purchase, delivery and storage at the Project Site for installation under other Sections or by the Owner.
- G. Install: Includes operations at the Project Site including the actual unpacking, preparation, assembly, erecting, placing, anchoring, supporting, connecting, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations required for a complete installation ready for the intended use.
- H. Provide: Provide means to furnish and install.
- I. Limit of Work: Limit of Work lines shown on Sections of Division 23 show the primary architectural area of work. Related work for the Facilities Services Subgroup may extend to new points of connection to existing systems beyond the indicated architectural limit of work area. Approximate locations of new connections are indicated in the contract documents.
- J. The words "demolish" and "remove" are used interchangeably in the Sections of Division 23, and shall mean: shut down, disconnect, disassembly and leave debris on floor for disposal under other sections.
- K. By Others: Provided under other sections of the specifications.
- L. Project Site: Project Site is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.

- M. Testing Agencies: A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.
- N. Product Data: Product data sheets include the manufacturers standard catalog information with illustrations, standard schedules, diagrams, performance charts, instructions, and brochures that illustrate physical appearance, size, weight, and other general characteristics of materials and equipment for some portion of the work.
- O. Shop Drawings: Shop drawings are detailed drawings, diagrams, illustrations, and schedules specifically prepared by the installing contractor or supplier to illustrate some portion of the work.
- P. Fabrication Drawings: The installation shop drawings required by the work of the various Sections of the Project Manual, such as sheet metal and sprinkler shop drawings, and normally prepared by the installing sub-contractor.
- Q. Coordination Drawings: The coordinated installation shop drawings normally prepared by the installing sub-contractors indicating multiple building systems and interdisciplinary work on a single set of coordinated documents.
- R. Piping: Includes all necessary piping system components, including pipe, fittings, couplings, gaskets, flanges, unions, valves, strainers, hangers, supports, attachments, insulation, and identification.
- S. Substitutions: Substitutions include manufacturers not listed as acceptable within the specifications, or materials, products, systems, or equipment, which differ from the requirements of the Contract Documents.
- T. Regulations: Regulations includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- U. NEC: National Electrical Code - NFPA 70.
- V. NRTL: OSHA recognized Nationally Recognized Testing Laboratory such as Underwriters Laboratory, Inc., Warnock Hersey, or Factory Mutual Research Corporation.
- W. Exterior or Exposed: Includes work exposed to the weather including work inside open parking structures and enclosures that are not heated and weather tight.
- X. Mechanical Systems: Includes all of the plumbing, fire protection, HVAC and related systems specified in Divisions 21 through 23.
- Y. Electrical Systems: Includes all of the systems specified in Division 26 through 28.
- Z. Life Safety Systems: Life Safety Systems include all fire protection systems, devices, and equipment used to detect fire, activate alarms, suppress or control fire and smoke, or any combination thereof.

1.4 SUBMITTALS

- A. General Requirements: Comply with Division 1 Sections regarding Submittals, the Sections of Division 23 and the additional requirements of this Section.

- B. Materials List: Within 30 calendar days after the Contractor has received the Owner's Notice to proceed, submit a list of the proposed materials to be provided under the work of Sections of Division 23.
- C. Organization of Submittals: Bind submittals into comprehensible packages with related product data sheets and shop drawings organized and identified by Specification Section and Article numbers and titles. Bind submittals into packages in order as specified in the Sections of Division 23. Identify submittal pages to indicate the specific equipment or fixture type the data sheet applies to by Article number and title. Submittals, which are not properly bound and identified, may be returned without review.
1. Indicate appropriate model numbers in manufacturers' brochures and cross out non-applicable information.
 2. Copies of faxed pages are unacceptable.
 3. Submit shop drawings for particular systems complete, simultaneously, and organized by system.
- D. Submittal Cover Sheet: Provide a completed cover sheet with each submittal package indicating the information on the following sample page:

SUBMITTAL COVER SHEET		
PROJECT:	CONTRACTOR:	
SECTION NO.:	ARTICLE NO.:	
DESCRIPTION:		
CONTRACT DRAWING REFERENCE NO.:		
EQUIPMENT IDENTIFICATION TAG NUMBER:		
SUBMISSION (CIRCLE ONE): FIRST, SECOND, THIRD, FOURTH		
DATE:		
INFORMATION AND CHECKLIST	REPLY	COMMENTS
1. Contractor's Log #ID		
2. Name, address, and phone number of supplier.		
3. Are all specified or scheduled items included and exactly match scheduled/specified items?	Yes No	
4. Is this item a substitution?	Yes No	
5. Are deviations clearly identified?	Yes No	
6. Does equipment fit space shown on construction documents, coordination drawings, and actual field conditions?	Yes No	
7. Has support, erection, weights, and installation been coordinated with all trades?	Yes No	
8. Does the proposed installation void warranties or violate UL or code requirements?	Yes No	
9. Does this material/equipment add expense to any other trade or project costs?	Yes No	
10. Does equipment require interface with other trades? List sections and specifics requiring coordination?	Yes No	
11. Is control interface coordinated?	Yes No	
12. List electrical characteristics (V/Ph/A)		

- E. After approval of the proposed materials list, provide complete submittals as soon as possible and with adequate time for processing in order to not delay the project.
- F. Submit for review of all project specific reproducible drawings, one reproducible and one print of each drawing. Submit for review eight sets of detailed Shop Drawings and Product Data. Submittals for review shall include complete Specifications, including type of materials, electrical characteristics, capacities, performance and power requirements to determine compliance with Contract Documents. All data submitted including wiring diagrams shall be complete for all equipment and shall apply only to this specific project. All extraneous material shall be deleted or marked out. Items to be supplied shall be specifically indicated using a method that will be visible after photocopying.
- G. Contractor's Review: Review, stamp and certify each submittal prior to submission to the Architect. The certification shall state that the data and details contained on each Shop Drawing, Product Data, layout drawing, catalog data and brochure has been reviewed and that it complies with the Contract Documents in all respects. Shop Drawings, layout drawings, catalog data and brochures will not be reviewed and will be returned unchecked unless they are certified and all items specifically identified.
- H. Multiple submissions: It is intended that Submittal data be complete and accurate at the first submission. If the Submittal is returned marked "Resubmit" only one additional submission will be permitted.
 - 1. If the second submission is not acceptable, or if the submittal is not made within the specified time frame, the right of substitution and selection will be lost. At that time the specified item shall be provided at no additional cost.
- I. Required Review Time: A minimum period of ten working days, exclusive of transmittal time, will be required in the Engineer's office each time Shop Drawings, Product Data, layout drawings, catalog data and brochures are submitted or resubmitted for review. A minimum period of fifteen working days exclusive of transmittal time will be required for reviewing substitute materials or manufacturer. The required review time, including multiple submission, shall be considered when scheduling the work.
- J. Submit Shop Drawings and Product Data sheets in a timely manner sufficiently in advance to give ample time for reviewing, correcting, resubmitting and re-reviewing if necessary. No claim for delay will be granted for failure to comply with this requirement.
- K. Equipment shall be of proper size for its allotted space. Equipment may be disassembled as required, where it does not invalidate the manufacturer's warranty, so that it can be installed through available window door, or louver openings.
- L. Schedule of Shutdowns: After the project construction schedule is developed, submit the following information to the Owner for all required shutdowns of existing systems.
 - 1. Date of proposed shutdown.
 - 2. List of systems to be affected.
 - 3. List of areas affected by the shutdown.
 - 4. Description of work to be performed.
 - 5. Estimated length of the shutdown.

- M. Piping Systems Schedule: Prepare and submit a schedule of mechanical piping systems to indicate the piping material, joints, and fittings to be used with each system.
- N. Insulation Schedule: Prepare and submit a schedule to indicate insulation types and thicknesses to be used on each mechanical piping system.
- O. UL Through-Penetration Firestop System Schedule: Prepare and submit a schedule to indicate the UL-System number for through-penetration assemblies to be used with all mechanical and electrical systems. Coordinate with the work of the Firestops and Smoke-seals Section in Division 7.
- P. Shop Drawings: Submit product data sheets and shop drawings as specified within Division 23.
- Q. Record Drawings: Prepare record drawings in accordance with the provisions of Division 1 governing - Project Record Documents and the additional requirements of this Section.
- R. Valve Tag Charts: Prepare and submit valve tag charts as specified in this Section.
- S. Operation and Maintenance Manuals: Prepare and submit copies of the Operation and Maintenance Manuals as specified in the appropriate Section of Division 1 governing - Contract Close-out the additional requirements of this Section.
- T. Training Seminar Confirmation: Prior to the final completion of the project, submit copies of the training seminar sign in sheets and a letter to the Owner containing the names of training seminar participants, including instructor's names, the name of the firms represented and the dates of the instruction seminars.
- U. Engineer's Action: Except for items submitted solely for record purposes or information, the Engineer will review each submittal for general compliance with the Contract Documents, as defined in the General Conditions, and return the submittal with comments.
- V. Action Stamp: The Engineer will attach a Submittal Review sheet to each submittal package to indicate the status of the submission and the action taken, as follows:
 - 1. Approved: Submission is generally in compliance with the intent of the contract documents and fabrication may be undertaken.
 - 2. Approved as Noted: Submission is generally in compliance with the contract documents and fabrication may be undertaken with the corrections noted.
 - 3. Revise and Resubmit: Submission is not in compliance with the contract documents and requires substantial corrections. Fabrication work may not be undertaken.
 - 4. Rejected: Submission is not in compliance with the contract documents. Resubmit as specified.
 - 5. Submit Specified Item: Second submission is not in compliance with the contract documents. Submit specified item without deviation.
 - 6. Reviewed For Comment Only: Engineer is not responsible for the approval of the submittal.

1.5 QUALITY ASSURANCE

- A. Qualifications: Use adequate numbers of skilled, licensed workers who are thoroughly trained and experienced and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Standard of Quality: The manufacturers names specified first or scheduled on the drawings are used for the design and to establish the standards of function, dimension, space requirements, appearance, and quality upon which the Contract is based. Acceptable manufacturers' names are listed to provide competitive bids with the specified or scheduled manufacturer.
 - 1. Whenever a product is specified by using a proprietary name or the name of a particular manufacturer or vendor, the specific item mentioned shall be understood as establishing type, function, dimension, appearance, and quality desired unless specifically identified "no substitutions allowed". Other manufacturers' products might be accepted, provided sufficient information is submitted to allow the A/E to determine that products proposed are equivalent to those named.
 - 2. Acceptable Manufacturers: The inclusion of a manufacturer's name within the list of acceptable manufacturers does not necessarily mean that the manufacturer's standard product is equal to the specified or scheduled product without some required modification. The submitted product shall be equal in terms of quality, durability, appearance, space requirements, weight, strength, sound performance and design to the product required by the Contract Documents.
 - 3. All electrical equipment and components shall be listed in compliance with NFPA 70 – National Electrical Code.
- C. Contractor's Review: It is solely the Contractor's responsibility to verify that the products of acceptable manufacturers and proposed substitutes meet or exceed the performance of the specified or scheduled product. To be considered acceptable, products must comply with the following for the full possible performance range:
 - 1. Horsepower: Equal or less.
 - 2. Efficiency: Equal or greater.
 - 3. Capacities: Equal or greater.
 - 4. Space/Clearances: Equal or greater.
 - 5. Storage and Recovery: Equal or greater.
 - 6. Warranty: Equal or better.
 - 7. Weight: Equal or less.
 - 8. Noise: Equal or quieter.
 - 9. Short Circuit Rating: Equal or greater.
- D. Substitutions: Substitutions include manufacturers not listed as acceptable within the specifications, or products, systems and methods, which differ from the specified systems.
 - 1. Comply with the provisions of the Instructions to Bidders and pertinent sections in Division 1. Submit list of proposed substitutes for review and approval in compliance with the Instructions to Bidders, AIA Document A701.
 - 2. By the submission of a proposed substitution, the Contractor represents that he has reviewed the proposed substitution and certifies that:

- a. The proposed substitution does not affect dimensions shown on drawings.
 - b. Changes to the building design, including A/E design and review time at a rate of 2.6 x DPE, detailing and construction costs caused by the requested substitution will be included in the bid price with no additional cost to the Owner.
 - c. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
 - d. Maintenance and service parts are available locally.
 - e. All costs associated with or caused by the use of the proposed substitute will be covered by the Contractor.
- E. Codes and Regulations:
 - 1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies and authorities that have jurisdiction.
 - 2. In case of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern.
- F. Qualifications for Welding and Brazing Work:
 - 1. Qualify welding processes and welding operators in accordance with AWS Standard Qualification Procedure."
 - 2. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
 - a. If recertification of welders is required, retesting will be Contractor's responsibility.
- G. Standards: Maintain copies of the most recent editions of the following standards at the job site for reference during construction:
 - 1. UL Through Penetration Fire Stop Systems.
 - 2. SMACNA Fire Damper Installation Guide.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protection (general): Use all means necessary to protect materials of the Sections of Division 23 before, during and after installation and to protect installed work and materials of all trades and Sections.
- B. Protection: Ductwork, VAV terminal units, fans, sound attenuators, etc. shall come from the factory/shop with protected with 2.5 mil Dual Film Polyethylene on every opening. If film becomes damaged or removed, replace.
- C. Replacements: In the event of damage, immediately make all repairs and replacement necessary to the approval of the Architect at no change in Contract Sum.

1.7 PROJECT CONDITIONS

- A. Comply with Article 2 of the Instructions to Bidders, AIA Document A701, including the Appendix. Visit the site prior to submission of bids and examine existing conditions to be familiar with the related implications to the Work of the Facility Services Subgroup Divisions.
 - 1. Questions regarding the Bidding Documents: Submit questions and requests for clarifications in compliance with the Instructions to Bidders.
- B. Contract Documents: The Contract Drawings are diagrammatic and do not show every fitting and component and shall be used in conjunction with the specified requirements to provide complete and fully functional systems for the intended use. The drawings and specifications are complimentary, and the requirements indicated on both establish the requirements of the Contract.
 - 1. The Contract Drawings indicate the general locations of equipment and distribution systems throughout the project. The actual installation locations shall be coordinated by the contractor on site based on actual field measurements performed by the contractor.
- C. Document Review: Review the complete set of Contract Documents and be familiar with the space requirements and work of other Sections. Thoroughly review building sections, architectural details, space availability phasing requirements and Facility Services Subgroup Divisions drawings for a complete understanding of the scope and coordination requirements of the Facility Services Subgroup Divisions.
- D. Scheduled Equipment: Standard manufacturers model numbers scheduled on the drawings shall be modified as specified in the descriptive specification for the scheduled equipment. The drawings generally define quantities, and the specifications further define equipment quality and system components, which may not be included in the standard model number.
- E. Pipe sizing notations: Pipe sizing notations run along the pipe from the larger sizes to the smaller size. Sections of pipe, which are not specifically identified with a pipe size, are the continuation of the previous larger pipe size indication. Pipe sizes change only where indicated by a notation change.
- F. Existing Conditions: The existing conditions indicated on the contract drawings are taken primarily from existing record drawings provided by the Owner and do not necessarily indicate actual as-built conditions. Preparation work of the Facility Services Subgroup Divisions includes the verification of existing conditions before the start of related installation work.

1.8 COORDINATION DRAWINGS

- A. Prepare coordination drawings for the Sections of Division 23 in compliance with the requirements of Division 1 and the additional requirements of this Section.
- B. Coordination drawings shall indicate how work provided under different sections will be coordinated and installed in the available spaces. Coordination drawings shall also indicate the sequence of installation work of the various sections. Coordination Drawings shall include work by sub-contractors and fabricators when off-site fabrication of work and production materials will interface with other trades.

- C. Each of the following sub-contractors shall indicate their work on architectural backgrounds available on AutoCAD electronic files. Coordination drawings shall show the work of all major trades without excluding the work of any particular trade. Coordination drawings shall include, but not be limited to, the work of the following trades:
1. Sheetmetal
 2. Plumbing
 3. Sprinkler/Fire Protection
 4. Electrical
 5. Telecommunications
 6. Security
- D. Contractor shall produce 3/8 inch scale or larger, reproducible mylar transparencies produced on AutoCAD 2008 that shall include the following general information:
1. Outline of all structural grid reference lines.
 2. Elevation reference lines.
 3. Structural steel beam sizes and column layout.
 4. Partition and door layout.
 5. Room or space number.
 6. Fire rating of partition penetrations.
 7. Acoustical ceiling layout.
 8. Firewalls and smoke partitions.
- E. Copies of the coordination drawings shall be distributed to each subcontractor and subsequently each trade shall indicate its work and show elevations, sizes, pipe and duct insulation, junction boxes, and fixture sizes.
- F. Conflicts shall be identified for immediate attention and resolution. Upon resolution of all conflicts, the coordinated drawings shall be signed by all trades and submitted to the Architect in accordance with Section 01300, for review and confirmation of compliance with the Contract Documents.
- G. Additional work required to accommodate a trade that failed to coordinate his work in a timely manner will be paid for by the subcontractor who failed to coordinate his work.
- H. Where conflicts occur regarding the location of materials of various trades, the Contractor will be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initiated and dated by the specialty trade. The Contractor shall then final date and sign each drawing.

- I. A sub-contractor who fails to promptly review and incorporate his work on the drawings shall assume full responsibility of any installation conflicts affecting his work and of any schedule ramifications.
- J. Fabrication shall not start until such transparencies of completed coordination drawings are received by the Architect and have been reviewed.
- K. Review of coordination drawings shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with Architectural, Structural, Mechanical, Electrical and other work.
- L. Coordination Drawings shall include the following work:
 - 1. Structural elements.
 - 2. Partition/room layout.
 - 3. Ceiling grid.
 - 4. Lighting fixtures.
 - 5. Smoke and heat detectors.
 - 6. Access panels.
 - 7. Sheetmetal, heating coils, boxes, grilles, diffusers, air flow stations, etc.
 - 8. All HVAC piping and valves.
 - 9. Fire and smoke dampers.
 - 10. Fire rated sleeves.
 - 11. Soil, waste and vent piping.
 - 12. Water mains and branches.
 - 13. Medical and specialty gas systems.
 - 14. Fuel gas piping systems.
 - 15. Roof drain piping.
 - 16. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit.
 - 17. Miscellaneous metal support.
 - 18. Fire standpipes and distribution piping.
 - 19. Sprinkler piping and heads.
 - 20. Heat tracing of piping.
 - 21. Telecommunication and Building Control Conduits.

- 22. Seismic restraints.
- 23. Code required clearances around electrical equipment.

1.9 WARRANTY

- A. Upon completion of the Work and as a condition of its acceptance and final payment, deliver to the Architect two copies of a written Warranty agreeing to replace the work of Sections of Division 23, which fails due to defective materials or workmanship within one year after Date of Substantial Completion as that date is determined in accordance with the General Conditions. All refrigeration compressors shall have the manufacturer's extended warranty for a total of five years.
- B. Failure due to defective materials or workmanship is deemed to include, but is not to be limited to:
 - 1. Failures in operating component or components.
 - 2. Leakage from piping system.
 - 3. Code violations.
- C. Obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.
- D. Replace material and equipment that require excessive service during warranty period as defined and as directed by Architect.
- E. Warranty shall include 24-hour service of complete system during warranty period at no cost to Owner. Choice of service organization shall be subject to Owner's approval.
- F. Include copy of warranty in the Operation and Maintenance Manuals.
- G. At end of warranty period, transfer manufacturer's equipment and material warranties still in force to Owner.
- H. This Article shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

1.10 MANUALS AND INSTRUCTIONS

- A. Comply with pertinent provisions of the appropriate Section in Division 1 regarding - Contract Closeout.

- B. Operation and Maintenance Manuals: Bind Manuals in hardcover, three-ring binders, and provide identified dividers with tabs. Also, provide a PDF copy of the entire manual. Indicate appropriate model numbers in manufacturers' brochures and cross out non-applicable information. Review the Manuals with the Owner's maintenance personnel and add additional maintenance data sheets and information as directed by the Owner's Representatives. Copies of faxed pages are unacceptable.
1. Obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items. Assemble literature in coordinated manuals with additional information describing combined operation of field-assembled units, including as-built wiring diagrams. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment.
 2. Provide directions for and sequences of operation for the Sections of Division 23. Sequence shall list valves, switches, and other devices used to start, stop and control systems.
 3. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment. Include additional instructions necessary for implementation of first-class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.
- 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. Organization of Manuals: Divide manuals with identified tabs to match the Facility Services Subgroup specification sections numbers and titles. Separate product information within each section by the Article numbers and titles as listed in Part 2 of each specification section. Provide a clear see-through plastic holder on the edge of the binder with a typed card indicating the Project name, the Engineer's name, the Installer's name and the Volume number (e.g., Vol. No. 1 of 2).
- E. Manuals shall include the following materials and information for all specified materials and equipment:
1. Table of contents.
 2. Emergency instructions with 24-hour phone number to contact a responsible individual for each Section of Work.
 3. Subcontractor's warranties and certificates of completion.
 4. Name and telephone number of local representative and supplier.
 5. Manufacturers' maintenance procedures.
 6. Exploded drawings and parts lists.
 7. Troubleshooting checklists with potential problems and possible causes.
 8. Schematic wiring diagrams.
 9. Record drawings.

10. Valve tag charts.
 11. Equipment warranties and guaranties.
 12. Sequence of Operations and Systems Descriptions.
 13. Additional requirements specified in other sections.
- F. Maintenance Information: Systems which require preventive maintenance to maintain efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions, as specified by the manufacturer, shall be stated clearly and incorporated on a readily accessible label on the equipment. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product.
- G. Instruction Seminars: Perform systems instruction seminars and walk-through with the Owner's designated representatives after preparation, review and approval of the Operation and Maintenance manuals by the Architect and Owner.
1. Perform detailed instruction seminars, prior to the completion of the Work, presented to the responsible personnel designated by the Architect. The seminars shall cover the operation and maintenance of all Work installed under Sections of Division 23. All instruction seminars shall be recorded and turned over to the owner on DVD or USB format using a recording software approved by the owner. Recording training sessions shall be of professional quality and performed by a firm regularly engaged in that business. A letter with two (2) copies containing the name of the person or persons to whom the instructions were given and the dates of the instruction period shall be submitted to the Architect at the completion of the project.
 2. Record the names of personnel and firms (subcontractors) represented and all training seminar participants, including all instructors and manufacturers' representatives on a seminar sign in sheet.
 3. During the instruction period the Operation and Maintenance Manual shall be used and explained.
- H. As a minimum training sessions shall consist of the following:
1. General project information and review shall be by the General Foreman or Superintendent of the Trade.
 2. Specific system and equipment training shall be by a Factory Trained Representative.
 3. Provide a complete review of the project and systems including, but not limited to, the following:
 - a. In a classroom environment mount the drawings on an easel or equivalent and review each Record Drawing (can use typical).
 - b. Note equipment layouts, locations and control points.
 - c. Review each system.

- d. Review system design operation and philosophy.
 - e. Review alarms and necessary responses.
 - f. Review areas served by various equipment and systems.
 - g. Identify color codes used.
 - h. Review features and special functions.
 - i. Review maintenance requirements.
 - j. Review operation and maintenance manuals.
 - k. Respond to questions (for videotaping, record questions and answers).
4. After classroom training, walk the entire project, review each equipment room and typical locations. Explain equipment and proper operation.

1.11 RECORD DOCUMENTS

- A. Prepare record documents for the work of the Sections of Division 23 as specified in Division 1 for Project Record Documents. The record drawings shall accurately indicate all valve locations and shall clearly show the assigned valve tag number. Record drawings shall include:
- 1. Piping and equipment location changes from the Contract Documents.
 - 2. Updated schedules to indicate the scheduled characteristics of the actual installed equipment.
 - 3. Valve locations and valve tag numbers.
 - 4. Equipment identification numbers coordinated with the Owner's Facility Management Program.
 - 5. Locations of seismic restraints.
- B. Record drawings include ductwork, sprinkler and fabrication drawings required for all other systems and coordination drawings prepared under the work of this contract. Provide polyester mylar reproducible drawings and electronic AutoCAD 2010 drawing files of both the contract drawings and additional fabrication/coordination drawings that indicate Facility Services Subgroup systems. All AutoCAD files shall be fully bound and submitted on CD format along with PDFs of each drawing. If the architect is using Revit, .RVT files are acceptable. These files should be in the same version used in the project.
- C. Submission of the specified polyester mylars of the full Facility Services Subgroup coordination drawings eliminates the requirement to modify the contract drawings to incorporate the changes to piping and equipment locations made during construction.

1.12 ELECTRONIC DRAWING FILES

- A. Electronic drawing files of floor plans and schedules on AutoCAD 2010, DXF format or Revit will be made available by the engineer for the contractor's use to prepare fabrication, coordination or record drawings. After the contractor requests the electronic files, a waiver will be provided for the contractor to sign and return to WSP. A service

charge of one hundred dollars (\$100.00) per drawing will be charged to cover the cost of the engineer's time and materials. After WSP receives the signed waiver the electronic drawing files will be forwarded to the contractor.

PART 2 - PRODUCTS

2.1 ELECTRICAL EQUIPMENT LISTINGS AND APPROVALS

- A. Reference Standards: All electrical equipment and systems shall comply with the following standards:
 - 1. NFPA 70 – NEC (2017 Edition)
 - 2. NFPA 79 – Industrial Machinery Code (2007 Edition)
 - 3. OSHA part 1910
- B. All Electrical equipment, devices, materials and systems provided under the work of Sections of Division 23 shall be UL listed and labeled. Where a UL listing is not available, submit the test reports of a NRTL testing engineer hired under the work of the Sections specifying the equipment. The NRTL testing engineer shall perform field testing to confirm that all electrical equipment, devices, materials and systems are in conformance with all applicable standards as well as State and local codes as enforced by the local inspector. All NRTL tests and inspections required for approval shall be performed under the work of the related Section at no additional cost to the Owner.
- C. All electrical equipment including starters, variable frequency drives, control panels, etc. shall be rated 65,000 symmetrical amperes at 480 volt and 42,000 symmetrical amperes at 208 volt.

2.2 SLEEVES AND PENETRATIONS

- A. Piping penetrations through fire rated construction shall comply with a listed fire rated assembly as detailed in the UL Fire Resistance Directory. Pipe sleeves through floors, exterior walls and fire-rated construction shall be galvanized Schedule 40 steel pipe. Pipe sleeves through non-fire-rated partitions shall be 26-gauge galvanized steel.
 - 1. Sleeves Through Foundation Walls: Provide galvanized schedule 40 steel with continuous weld slip on welding flange water stop. Provide waterproof resilient link caulking assembly by Link-Seal or Sure-Seal for plumbing, electrical and mechanical systems.
 - a. Fire Service Entrances: Provide waterproof mastic or silicone sealant equal to GE Silicone II XST at sprinkler and fire service entrances in conformance with NFPA 13.
 - 2. In areas where pipe or duct is exposed, install sleeves flush with the finish floor, except in mechanical rooms, janitor's closets and other potentially wet areas, extend sleeves at least 4 inches above finish floor.
 - 3. Annular Space Requirements: Sleeves shall be sized to provide a total clearance of 1/2 inch around pipe or duct including insulation cover. Annular space around fire rated through penetrations assemblies shall be in compliance with the Listed Assembly.
 - 4. Packing between the pipe and sleeve in fire rated construction shall be a combination of listed insulation and fire-proof caulk. Coordinate with the work of the Division 7 Section for Firestops Smoke-seals.

5. Installation of recessed boxes, panels and cabinets installed in fire-rated walls shall be fire rated or installed with a listed fire rating assembly equal to the rating of the wall.
 6. Core drilled holes in lieu of sleeves are acceptable except in mechanical rooms, janitor's closets and other areas with plumbing fixtures or equipment with water connections, which require sleeves installed above floors.
 7. Non-Fire Rated Penetrations: Provide 26 gauge galvanized sheet metal sleeves at all plumbing and mechanical piping sleeves through non-rated partitions. Sleeves are not required on electrical conduit or fire protection piping.
- B. Duct sleeves through fire-rated construction shall be of the same gauge as the related fire damper sleeve. See SMACNA Fire, Smoke and Radiation Installation Guide for HVAC Systems. The sleeve shall be sized to provide the necessary clearance required for expansion of the fire damper sleeve in conformance with UL approval. Duct sleeves through non-fire-rated partitions shall be 26-gauge galvanized steel. Duct sleeves through non-fire-rated floors and exterior walls shall be 16-gauge galvanized steel.
1. Packing for sleeves that do not require maintenance of fire rating shall be silicate foam, ceramic fiber, or mineral fiber with approved sealant. Pack or foam to within 1 inch of both wall surfaces. Seal penetration packing with approved caulking and paintable waterproof mastic surface finish or silicone caulking.
 2. Openings in walls, partitions and other fire rated construction that do not require smoke dampers shall meet NFPA 90A, Section 3-3.8.
- C. Through Penetration Assemblies: The combination of materials shall have the same fire rating, in hours, as the wall or floor, as tested in accordance with the code referenced editions of ANSI/UL 1479 (ASTM E-814). The combination of materials shall be classified by UL for the fire rating required and shall be listed as a numbered system in the UL Fire Resistance Directory.
1. Caulking of pipe and duct penetrations through floor slabs, smoke barriers and fire rated partitions shall be performed under the Division 7 Section for Firestopping.
- D. Waterproof Pipe Penetrations:
1. Modular mechanical penetrations seals shall be interlocking synthetic rubber links shaped to fill annular space continuously, with galvanized carbon steel bolts, nuts and pressure plates to expand rubber seal between pipe and sleeve. Sleeve seal shall be water-tight.
 2. Prefabricated modular sleeves shall be Mason Industries (SWS) or approved equal stiffened galvanized steel sleeves with preformed closed-cell elastomeric seal (non-fire-rated) or preformed mineral fiber or silicone foam seal (fire-rated).
 3. Provide waterproof 1" single ring set in silicone and bolted to floor or wall at chipped and drilled penetrations of existing slabs on grade and existing walls below grade.
- E. Provide adjustable escutcheons on exposed piping that passes through finished floors, walls, and ceilings. Escutcheons shall be chromium-plated cast brass, sized to cover sleeve opening and to accommodate pipe and insulation.

- F. Exposed Duct Through Finished Floors, Walls or Ceilings: Provide 4" wide 20 gauge galvanized sheet metal collars at sleeves and prepared openings, sized to cover entire duct penetration including sleeve and seal, and to accommodate duct and insulation as necessary. Edges shall have milled lips ground smooth. Paint to match finish of duct or as directed by Architect.

2.3 VALVE TAGS & VALVE TAG CHARTS

- A. Identify all valves on this project as described. Attached tags using solid brass chain and "S" hooks so they are easily visible but do not obstruct the operation of the valve.
- B. Provide valve tags on all controlling valves installed and related to this project, except obvious drain and vent piping. Match service abbreviations with drawings.
- C. Valve Tags shall be approximately 19 gauge brass and no less than 1 ½" in diameter. Tag shall be stamped and black filled with a service abbreviation and a sequential number. The service abbreviation shall be on the top line and be no less than ¼" in height. The sequential number shall be on the bottom line and shall not be less than ½" in height. If necessary, to accommodate longer abbreviations or number sequences increase tag size to 2" in diameter.
- D. Attach valve tag to the stem or body of the valve so that the tag is visible but doesn't interfere with the valve operation.
- E. Attach each valve tag using the following products. #16 Solid Brass Jack Chain, 1-½" Solid Brass "S" Hooks, # 6 Solid Brass Beaded Chain.
- F. Valve Tag Charts
 - 1. Prepare valve tag charts to indicate the location of all valves by room name and number as identified on the architectural floor plans. Indicate areas, floors, or specific rooms controlled by each valve. Provide valve tag charts for each system as specified in Part 2 of this Section.
 - 2. Valve Schedule Frame: Install an 8 ½" x 11" aluminum valve chart frame in a conspicuous location inside the mechanical room or as directed by the owner or engineer. The chart should contain the following information about each tag: Service Abbreviation, Valve Number, Valve Location and Valve Function. To protect the chart, the frame should be supplied with a 10 mil clear plastic cover.
 - 3. Provide a valve schedule to the engineer for approval.
 - 4. Coordinate valve tag numbers with the Owner's facility management programs.
- G. Designations
 - 1. HVAC Systems:

a.	Condenser Water Supply	CWS
b.	Condenser Water Return	CWR
c.	Boiler Feedwater	BF
d.	Heating Hot Water Supply	HWS
e.	Heating Hot Water Return	HWR
f.	Pumped Condensate	PD
g.	Cold Water	CWS

- H. Valve tags on plumbing systems may be engraved laminated plastic tags color-coded to match the pipe identification marks.
- I. Identify non-potable water outlets with permanently attached yellow color-coded marker or 4-inch high triangle tag reading: Water Unsafe.

2.4 IDENTIFICATION OF PIPING, DUCTWORK AND EQUIPMENT

A. Description of Work

- 1. Work in this section includes: Identification materials, including necessary accessories indicated on Contract Documents and specified in this section or as required for proper identification of equipment and piping.
 - a. Pipe Markers
 - b. Equipment Nameplates
 - c. Duct Markers

B. Quality Assurance and Reference Standards

- 1. The latest published edition of a reference shall be applicable, unless identified by a specific edition date.
- 2. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - a. ANSI / ASME A13.1 2007: "Scheme for the Identification of Piping Systems"
 - b. ANSI Z535.1 2007: "Safety Color Code"
 - c. NFPA 99C: "Standard on Gas and Vacuum Systems"

C. Submittals

- 1. Submit product data sheets on all products contained in this section for approval. Data sheets must substantiate conformance with applicable standards.

D. Coordination

- 1. Coordinate installation of identifying devices with the completion of covering and painting of surfaces where devices are to be applied.
- 2. Coordinate installation of identifying devices with the location of access panels and doors.
- 3. Install identifying devices before installing acoustical ceiling tiles or similar concealment.

E. Manufacturers

- 1. Provide manufacturers standard products that conform to ANSI / ASME A13.1 2007 requirements for lettering size, background size, background color, and angle of installation.
- 2. Acceptable manufactures are Seton, Brimar Industries, Emedco or approved equal.

F. Pipe Markers

1. General: Pipe Markers shall comply with ANSI / ASME A13.1 2007 "Scheme for the Identification of Piping Systems" and be installed as required and indicated below using legends spelled out fully with few abbreviations and directional arrows to indicate flow. Arrows must have the same background color as the pipe marker legend, or be incorporated into the pipe marker.
2. Color: Pipe markers shall conform to ANSI Z535.1 "Safety Color Code"
3. For pipes with an overall diameter of 6" or less (including insulation), provide semi rigid plastic wrap around pipe marker that extends 360° around the pipe at each marker location. The semi rigid marker should include the legend (pipe content) and a directional flow arrow. The marker shall be supplied as a pre-tensioned device and be equipped with a 1/2" strip of adhesive on the inside to further secure the marker in a permanent position on vertical locations.
4. For pipes with an overall diameter greater than 6" (including insulation) provide a semi rigid plastic strap-on pipe marker with a height no less than 3 times the letter height. The marker shall include a legend (pipe content) and a directional flow arrow. The marker shall be supplied with no less than two nylon straps to secure the marker in place.

G. Equipment Nameplates

1. Provided an engraved multi-layered plastic laminated nameplate for all equipment. Provide an engraved nameplate for each disconnect, VFD, starter, controller, etc. connected to equipment.
2. Provide a 1/8" thick black Phenolic material engraved nameplate with white letters for all equipment. The nameplate shall be a minimum of 3" high x 6" wide.
3. The minimum letter height shall be 3/4". If necessary enlarge the size of the plate to accommodate the 3/4" characters. Do not reduce the letter height.
4. The nameplate shall be installed with stainless steel screws.
5. The nameplate shall be engraved with the Equipment Tag as shown on the mechanical drawings and schedules.
 - a. Name and number of the equipment (Example – AHU-1)
 - b. Make, model and serial number
 - c. Coordinate with the owner to follow any building/owner standard
6. Equipment markings shall be prominently displayed on each normally visible side of equipment.
7. Equipment intended for installation in finished area shall have markings located behind normally used access panels mounted so as to be readily found.

H. Equipment Nameplates – Fire Damper, Smoke Damper and Fire/Smoke Damper Markers

1. Provided an engraved nameplate for each fire, smoke and fire/smoke damper.

I. Access Panels

1. Provide a 1/16" thick white nameplate with black letters to identify access to concealed valves or equipment such as those found above acoustical ceilings tiles. The nameplate shall be 3/4" high x 2 1/2" wide. The minimum letter height shall be 1/4".
2. Coordinate the information to be engraved on each plate so that it exactly matches the valve tag or equipment nameplate. Install these nameplates on the ceiling support to the right of the tile that would provide access.
3. Nameplates should be installed using with stainless steel screws.

J. Duct Markers

1. Provide pressure sensitive vinyl labels on all ductwork installed on this project to identify the basic content and directional flow of the duct.
2. Utilize manufacturer's standard legends such as: Exhaust, Exhaust Air, Intake, Intake Air, Outside Air, Relief, Relief Air, Return Air or Supply Air.
3. Smaller Ducts: On ducts up to 24" in size provide a duct marker that is a minimum of 2 1/4" x 16" and has a letter size of 1 1/2". Each marker must be supplied with a directional flow arrow.
4. Larger Ducts: On ducts larger than 24" in size provide a duct marker that is a minimum of 4" x 24" and has a letter height of 2 1/2". Each marker must be supplied with a directional flow arrow.

K. Preparation

1. All surfaces that are to receive adhesive applied mechanical identification such as Pipe, Duct, and Equipment nameplates should be clean and dry prior to application.

2.5 PRESSURE VESSELS

- A. Pressure vessels including, but not limited to; domestic water heaters, boilers, compressed air and vacuum receiver tanks provided under Division 23 shall be ASME rated construction.

2.6 MASTICS, ADHESIVES, SEALANTS AND TAPES

- A. Provide low VOC mastics, adhesives, sealants and tapes in compliance with South Coast Air Quality Management District Rule #1168 VOC Limits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect site conditions before starting preparatory work and verify that actual conditions are known and acceptable before starting work. Be familiar with the work of other sections, separate contractors, and the Owner.
- B. Inspect areas where piping, conduit, ductwork, fixtures and equipment will be installed and verify adequate space is available for access, service and removal of equipment. Coordinate with the Work of other Sections.

- C. Notify the Architect immediately when the removal of existing ceilings, walls, or obstructions reveal conditions substantially different from the Contract Documents.

3.2 PREPARATION

- A. Perform coordination with the work of other Sections and prepare composite coordination drawings as specified in this Section before starting installation work of Divisions 20 through 26.
- B. Verify points of connection to existing systems and confirm that required system shutdowns are acceptable with the Owner before proceeding with any related installation work.

3.3 SYSTEM SHUTDOWNS

- A. Coordinate shutdowns of existing systems with the Owner and submit a written request at least ten working days in advance. Minimize system shut downs as much as possible. Submit a list of all affected areas, the proposed work to be performed, and the expected length of the shutdown including time for retesting.
- B. Perform phasing and provide temporary services to maintain existing active services serving areas outside the limit of work area. Provide new services in place or temporary systems to re-feed existing systems affected by demolition work before starting shutdown and demolition work. Mechanical and electrical systems of Divisions 20 through 28 pass through the area to be demolished and shall be maintained active for areas outside the work area except for shutdown time for new service connections.

3.4 LIFE SAFETY SYSTEMS SHUTDOWNS

- A. Impairment Permits: Coordinate the preparation of Impairment Plans for existing Life Safety systems with the work of Division 1 Sections on Permits and Temporary Facilities. Obtain impairment permits from the local Authorities Having Jurisdiction for all Life Safety Systems affected by the work of Sections of Division 23.
 - 1. Submit the proposed Impairment Plan to the local Authorities Having Jurisdiction for review and approval. Maintain the existing Life Safety Systems in operation during construction in conformance with the impairment permits obtained from the local Authorities Having Jurisdiction. Perform work and provide temporary services to maintain active systems and perform phasing of new work in compliance with the approved impairment plan.
- B. Safeguarding Construction: Provide fire watch, portable extinguishers, and safety procedures in compliance with NFPA 241.

3.5 DEMOLITION WORK

- A. Take care to avoid creating hazards on the site or causing disruption of service in the adjoining areas to remain active.
- B. Remove all abandoned piping, ductwork and equipment not built into building construction. Where ceilings or walls are removed all abandoned duct, conduit and piping shall be removed. Abandoned elements built into walls or located above existing ceilings that are not being removed shall remain. All duct and pipe ends shall be capped and be marked abandoned.

- C. Shut off, disconnect, make inactive and dismantle existing mechanical and electrical systems to be demolished and leave debris on floor for removal under Division 2. Disconnect and make safe existing equipment to be demolished and identify items to be removed with orange spray paint for removal and disposal under Divisions 1 and 2.
- D. Remove existing systems serving areas to be demolished. Remove systems back to active main and make safe and provide cap or plug to suit system. Obtain existing record drawings from Owner. Maintain existing systems serving areas to remain.
- E. After walls and ceilings are removed and piping is exposed, verify exposed mechanical and electrical systems serve only areas indicated for demolition before shutdown for disconnection. Identify existing systems which serve areas to remain. Promptly notify Architect of active systems to be maintained when located in partitions to be demolished.
- F. Remove existing active systems located in existing partitions to be demolished and provide new off-set at ceiling and drop through floor and reconnect to existing services at the floor below.

3.6 CORE DRILLING

- A. Do not core new concrete structure without written approval from the Structural Engineer.
- B. Perform all core drilling required for the proper installation of the work of Divisions 20 through 26. Locate all required openings and prior to coring coordinate the opening with the other Trades and obtain approval from the Structural Engineer.
- C. Thoroughly investigate the existing conditions in the vicinity of the required opening prior to cutting. Take care so as not to disturb the existing building systems. Damage to existing conditions incurred during core drilling shall be corrected to the Owners satisfaction with no additional expense to the Owner.

3.7 CUTTING AND PATCHING

- A. Cutting and patching shall be performed under other Sections. Locate all other than cored openings required for the installation of the mechanical piping systems. Coordinate the opening with the work of the other trades so as not to interfere with the work of other Sections. Thoroughly investigate the existing conditions in the vicinity of the required openings as much as possible.
- B. Patching of the existing walls around openings shall be performed by the respective trade responsible for the finish material in which the opening is made.

3.8 SLEEVES AND PENETRATIONS

- A. Coordination: Closely Coordinate electrical conduit, mechanical piping and ductwork penetrations through floor slabs and fire rated walls with the other Sections of Divisions 20 through 26 and the requirements of Division 7 - Fire Stops and Smoke Seals. Penetrations through fire rated construction shall consist of a complete rated assembly.
 - 1. UL -Listed through Penetration Components: In addition to the fire stop caulking provided under Division 7, the components of a fire rated through penetration assembly include the piping size and material, annular space, and insulation type, density and thickness.
 - 2. Prepare a schedule of UL Through Penetration System numbers for submission and approval.

- B. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
- C. Extend sleeves through Mechanical Room and other potentially wet floors a maximum of 2 inches above finished floor level and provide pipe support sleeve.
- D. Install cast brass chrome plated escutcheons where piping passes through finished surfaces.
- E. Provide vertical flush wall cleanouts on the base of stacks just above the wainscot.
- F. Provide sheetmetal sleeves on piping through non-rated partitions.

3.9 GENERAL INSTALLATION REQUIREMENTS

- A. General: Coordinate with the work of other trades before starting installation. Install materials, equipment, including fixture and trim in accordance with the approved manufacturers latest printed installation instructions and the product NRTL listing requirements.
 - 1. Store materials on site in clean and dry conditions on racks off the floor or ground.
 - 2. Install piping straight, plumb and form right angles on parallel lines with building walls. Locate groups of pipes parallel to each other. Provide sufficient spacing for insulation and valve access.
 - 3. Install mechanical and electrical systems as high as possible to maximize ceiling heights.
 - 4. Piping components shall be of rust, from scale and dirt. Protect open ended pipe ends to prevent debris from entering. All piping shall be reamed free of burrs.
 - 5. Locate valves for easy access and operation. Install valve stems above the horizontal. Provide chain operators on all valves 4 inches and larger located 7 feet or higher above the finish floor.
 - 6. Piping connections to coils and equipment shall be made with off-sets provided with isolation valves, unions or flanges arranged so that equipment can be serviced or removed without dismantling.
 - 7. Provide for expansion and contraction in all piping systems to prevent undue strains on piping or equipment. Provide double off-sets at risers to take up expansion.
 - 8. Install equipment with care to minimize damage to shop applied finishes. Replace or repair damaged components or finishes incurred during shipping and installation to the Owners satisfaction.
 - 9. Thoroughly clean items before installation. Cap pipe openings to exclude dirt until fixtures are installed and final connections have been made.
 - 10. Cut pipe accurately and work into place without springing or forcing, and properly clearing windows, doors, and other openings.

11. Show no tool marks or threads on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.
12. Make changes in directions with fittings, make changes in main sizes with eccentric reducing fittings. Install water supply and return piping with straight side of eccentric fittings at top of the pipe.
13. Run piping concealed above ceilings and within furred spaces. Take special care to locate stacks and risers within pipe chases as indicated on the Architectural Drawings. Obtain approval from the Architect for piping locations which require furrings not indicated on the Contract Drawings.
14. Install equipment and components to minimize noise and vibration transmission to the structure. Provide vibration isolators and flexible connectors for all vibrating equipment.
15. Locate piping and equipment to maintain at least 18 inches clear in front of access panels and doors.
16. Provide sufficient swing joints, ball joints, expansion loops, and devices necessary for a flexible piping system.
17. Support piping independently at pumps, coils, tanks and similar locations, so that weight of piping will not be supported by the equipment.
18. Pipe the drains from pump glands, drip pans, relief valves, air vents and similar locations, to spill through an air gap into a floor drain.
19. Securely bolt all equipment, isolators, hangers, and similar items in place.
20. Provide complete dielectric isolation between ferrous and non-ferrous metals.
21. Do not install plastic piping systems when the ambient temperature is below 60 degrees F.
22. Install non-electrical systems at least 6 feet above electrical panels and equipment and provide drip pan with pipe to spill on the floor.
23. Provide Armstrong Armaflex 2000 white insulation on pipe hangers, duct hangers, duct flanges, the edge of ductwork, and to the sharp edges of mechanical systems when located below 6'-8" above the floor.
24. Insulating Clamps: Provide IPS Corp. Strap-Tite insulating clamps on uninsulated copper piping installed through metal stud perforations.
25. Provide temporary caps or test plugs on open piping during installation to prevent construction debris or trash from entering the system.

B. Installation of Grooved Piping Systems:

1. Grooved piping systems 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 by the manufacturer as suitable for the intended service.

2. Training: A factory-trained technical employee of the mechanical joint manufacturer shall provide on-site training of the installing contractor's field personnel in the proper use of grooving tools and installation of grooved piping products and provide certification of training. The factory-trained representative shall periodically review the product installation on-site and ensure best practices are being followed. A distributor's representative is not considered qualified to conduct the training.
 - a. Submit training certifications of for all installing personnel.
3. Measure all piping grooves prior to joint assembly with the appropriate tools to confirm that grooves conform to the manufacturer's specified requirements and tolerances.
 - a. Piping, grooves and installations found to be non-compliant with the specified requirements shall be removed and replaced.

C. Equipment Access for Maintenance and Removal:

1. Install piping, equipment and accessories to permit access for maintenance as specified by the equipment manufacturer. Provide adequate clearance to disconnect equipment for removal. Locate valves and unions so additional piping removal is not necessary to remove equipment. Coordinate piping and equipment locations with all trades to ensure adequate clearance is maintained for equipment maintenance and removal.
2. Relocate items as necessary to provide access for maintenance and removal without additional cost to the Owner.

D. System Flushing:

1. Perform system flushing of rough piping installation before final equipment and fixtures are installed.
2. Perform final flushing of piping systems through strainers, hose bibs and drain valves to remove debris from piping. Perform necessary cleaning of outlets at equipment and fixtures such as faucet aerators, flush valves, flow controls and shower heads to ensure proper function.

E. Protection of Mechanical and Electrical Systems:

1. Coordinate the requirements for physical protection of all mechanical and electrical systems with the work of other sections. Bollards, guardrails, bumper guards and barriers shall be provided under other sections.

3.10 ACCESS PANELS

- A. Access Panels: Comply with the appropriate Section of Division 8 specifying Access Panels.
- B. Furnish access panels for installation under other sections to allow access to mechanical equipment and devices installed under Divisions 20 through 26. Furnish access panels for mechanical and electrical devices installed behind permanent construction such as gypsum wallboard partitions and ceilings or concrete masonry walls and partitions.

- C. Devices provided under the work of Divisions 15 and 16 that require access include, but are not necessarily limited to; valves, cleanouts, air release valves; water hammer arrestors, trap primer devices, terminal boxes; fire and smoke dampers, smoke detectors, steam traps, slip joints, expansion joints, filters, coils, junction and pull boxes and volume and control dampers.
- D. Coordinate with the Architectural reflected ceiling plans, room elevations and finish schedules for locations where the above panels are applicable. Coordinate all work with the General Contractor/Installer. Locations of all access panels shall be coordinated with the Architect prior to locating items that require an access panel. Access panels will not be allowed in any wall finished with brick, structural glazed facing tile, or wood.
- E. Access panels shall be large enough to provide access for maintenance and removal of mechanical and electrical equipment and devices.
- F. Access panels shall have same fire rating classification as the construction penetrated.
- G. Panels shall be at least 12" x 12"; access panels at equipment shall be 18" x 18".

3.11 VALVE TAG CHARTS

- A. Prepare valve tag charts to indicate the location of all valves by room name and number as identified on the architectural floor plans. Indicate areas, floors or specific rooms controlled by each valve. Provide valve tag charts for each system as specified in Part 2 of this Section.
- B. Coordinate valve tag numbers with the Owner's facility management programs.

3.12 IDENTIFICATION OF PIPING, DUCTWORK AND EQUIPMENT

- A. Install all identification in accordance with the latest version of with ANSI A13.1.
- B. Pipe Markers
 - 1. Identify all piping on this project.
 - 2. Install pipe markers on long straight runs every 20 feet.
 - 3. Install pipe markers above and below every floor penetration and on either side of every wall penetration and insure there is at least one marker per pipe in every room.
 - 4. Install pipe markers at every valve, branch and any change in piping direction on all directions, sides, etc.
 - 5. Install pipe markers so they are visible for a normal standing position.
- C. Duct Markers
 - 1. Identify all ductwork on this project.
 - 2. Install duct markers every 20 feet on long straight runs.
 - 3. Install duct markers at all floor and wall penetrations and near all connected equipment and insure there is at least one marker per duct in every room.

4. Install duct markers at all branches and changes in direction of the duct so it is easily traced.
5. Install duct markers so they are visible for a normal standing position.

D. Equipment Nameplates

1. Identify all equipment, the location of concealed equipment, associated components and controls of all equipment.

E. Equipment Nameplates – Fire Damper, Smoke Damper and Fire/Smoke Damper Markers

1. Identify all fire dampers, smoke dampers and fire/smoke dampers
2. Install labels on the exterior of the dampers and/or ductwork if exposed or concealed.
3. Install labels on the access panel or ceiling grid if concealed above ceiling.

3.13 FIRE WATCH

- A. Provide a fire watch as required by Division 1 when performing work, which may cause a fire, such as welding or torch cutting work.

3.14 SCAFFOLDING, HOISTING, RIGGING AND STAGING

- A. Provide scaffolding, hoisting, rigging, conveyance apparatus and staging in conformance with Division 1 as required to perform the work specified in the other mechanical and electrical sections of Divisions 20 through 26.

3.15 RECORD DOCUMENTS

- A. Project Progress and Record Drawings: Comply with the appropriate Section of Division 1 governing Project Record Documents and the additional requirements of this Section.
1. Maintain a daily record of the project construction progress by coloring the work completed on the white prints furnished by the Owner at the commencement of the work.
 2. Modify the equipment schedules to reflect data consistent with that of the installed equipment. Clearly show all changes to the work as a result of addenda, change orders, clarifications, instructions issued by the Architect or conditions encountered in the field. Accurately indicate the location, size, type and elevation of new work and their relationship to existing work. Provide dimensions from permanent site improvements or column centerlines.
 3. The marked up and colored in prints will be used as a guide for determining the progress of the work installed. They shall be inspected weekly and shall be corrected immediately if found inaccurate or incomplete. Requisitions for Payment will not be approved until the Drawings are accurate and up-to-date.
- B. At the completion of the work submit one set of the marked up prints for review and acceptance. After acceptance, these marked up record prints shall be used to prepare the Owner's final Record Drawings.

- C. Maintain the established layering, color and pen thickness scheme on modified electronic drawing files.
- D. Make all modifications on the AutoCAD Drawing files indicated on the approved marked up set of Record Drawings. Remove all superseded data to show the completed installation.
- E. The final approved AutoCAD Record Drawing files shall become the property of the Owner.
- F. Deliver the completed Record Documents both in AutoCAD and PDF properly titled and dated to the Architect. These Record Documents shall become the property of the Owner.

3.16 SYSTEM START-UPS AND INSTRUCTIONS

- A. Start-Ups: Perform system and equipment start-ups in accordance with the manufacturers' printed start-up instructions in the presence of the manufacturers' representatives.
 - 1. Perform initial systems start up for all Life Safety Systems with the manufacturers' representatives and provide complete integrated systems testing and verification as detailed in the Fire Protection Narrative before notifying the approving Authorities having Jurisdiction. Make all necessary adjustments, corrections and changes and retest the systems with the manufacturers' representatives present during the final testing and preliminary acceptance tests.
 - 2. After the successful completion of all preliminary Life Safety Systems acceptance tests notify the approving Authorities having Jurisdiction.
 - 3. Perform the final Life Safety Systems acceptance tests as detailed in the Fire Protection Narrative with the Manufacturers' Representatives, Authorities having Jurisdiction and Owner's Maintenance and Facility staff in attendance.

3.17 CONSTRUCTION CERTIFICATIONS AND AFFIDAVITS

- A. Engineer's Responsibility: During construction the Engineer is responsible for the following services:
 - 1. Review, for conformance to the design concept, shop drawings, samples and other submittals, which are submitted by the contractor in accordance with the requirements of the construction documents.
 - 2. Review and approval of the quality control procedures for all code-required controlled materials.
 - 3. Be present at intervals appropriate to the stage of construction to become, generally familiar with the progress and quality of the work and to determine, in general, if the work is being performed in a manner consistent with the construction documents.

- B. Contractor's Responsibility: The Contractor is solely responsible for the completion of the work on schedule and in compliance with the Contract Documents and the applicable codes; and for scheduling sufficient time for all required testing and submissions and approvals.
1. Construction Affidavits: If the Building Official requires on-site representation from a Professional Engineer stating that the Contractor's work is in accordance with the approved construction documents and with applicable local, state and federal statutes and regulations as required by, the Contractor shall retain the services of a qualified Registered Professional Engineer to be on site during construction.
 2. Submission Schedule: Allow sufficient time for the initial submission; Architect/Engineer review; resubmission; and final review and approval of all documents required for acceptance of the request for a Certificate of Occupancy.
 3. Submit copies of the approved fire protection shop drawings, "As-Built" record drawings and completed contractor's test and material certificates to the building official and head of the fire department before scheduling the final fire protection/life safety systems operational acceptance tests.
 4. Testing Schedule: Allow sufficient time for the initial testing, adjustments, and final functional operational testing of all fire protection systems as outlined in the Fire Protection Narrative.
- C. Construction Certifications: After the General Contractor and the Facility Services Group Subcontractors submit signed Certifications of Compliance as required, the responsible engineers will provide written certifications to confirm that to the best of the engineer's knowledge, information, and belief, the finished work is in compliance with the approved drawings issued for permit as defined below:
1. Final Affidavits/Certifications will be signed by the Engineers of Record only after all specified systems are complete, tested and accepted as defined in: the Building Code and the applicable Referenced Standards; Divisions 21, 22, 23 and 26; and the Project Fire Protection Narrative filed with the permit documents.
 2. Prior to submission of the final signed Certifications of Compliance, the Contractor shall submit written responses to all punch list items submitted by the design team.
 3. It is the Contractor's sole responsibility to schedule all installation work, preliminary and final acceptance testing to allow at least 5 days for the engineer to review all documents, and final acceptance testing documentation before affidavits will be issued.
 4. The engineer will not submit certifications or affidavits until all required certifications of testing, compliance, acceptance and completion of punch list items have been submitted to the engineer and approved.

3.18 OEM CONTROLS INTEGRATION

- A. The contractor shall ensure that original equipment manufacturers (OEM), providing equipment with integral controllers (DDC, electronic), shall coordinate with the Building Controls System (BCS) contractor to ensure complete integration of the OEM controls with the BCS. Provision of any gateways, wiring, etc., shall be by the BCS contractor.

- B. The contractor shall refer to the Building Controls Systems drawings to ensure the sequences required by OEM equipment are followed.
- C. The OEM controllers shall coordinate with the BCS contractor to provide for the following, as applicable to the device, for connection by the BCS contractor.
 - 1. Remote start/stop.
 - 2. Remote set-point adjust.
 - 3. Remote alarming.
 - 4. Remote status.
 - 5. Remote monitoring of all process variables measured by the OEM controller. In short, all information that is available on the local OEM control panel shall be communicated to the BCS.

END OF SECTION

SECTION 230548 - VIBRATION ISOLATION AND SEISMIC/WIND RESTRAINTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vibration Isolation Devices:

- a. Elastomeric isolation pads.
- b. Elastomeric isolation mounts.
- c. Restrained elastomeric isolation mounts.
- d. Open-spring isolators.
- e. Restrained-spring isolators.
- f. Elastomeric hangers.
- g. Spring hangers.

2. Seismic Restraint Devices:

- a. Snubbers.
- b. Restraints - rigid type.
- c. Restraints - cable type.
- d. Restraint accessories.
- e. Post-installed concrete anchors.
- f. Concrete inserts.
- g. Vibration isolation equipment bases.

B. Related Requirements:

1. Division 21 for vibration isolation and seismic devices for fire-suppression equipment and systems.
2. Division 22 for vibration isolation and seismic devices for plumbing equipment and systems.

1.2 DEFINITIONS

- ##### A. Designated Seismic System: An HVAC component that requires design in accordance with ASCE/SEI 7, Ch. 13, and for which the Component Importance Factor is greater than 1.0.

- B. IBC: International Building Code.
- C. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic restraint component.
 - 3. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by an agency acceptable to authorities having jurisdiction.
 - 4. Annotate to indicate application of each product submitted and compliance with requirements.
 - 5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated Design Submittals:
 - 1. For each seismic-restraint device, including seismic-restrained mounting, snubber, seismic restraint, seismic-restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:
 - a. Seismic Restraint, and Vibration Isolation Base Selection: Select vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data.
 - b. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification by professional engineer that riser system was examined for excessive stress and that none exists.
 - c. Concrete Anchors and Inserts: Include calculations showing anticipated seismic and wind loads. Include certification that device is approved by an NRTL for seismic reinforcement use.
 - d. Seismic Design Calculations: Submit all input data and loading calculations prepared under "Seismic Design Calculations" Paragraph in "Performance Requirements" Article.
 - e. Qualified Professional Engineer: All designated-design submittals for seismic restraint calculations are to be signed and sealed by qualified professional engineer responsible for their preparation.
 - 2. Seismic Restraint Detail Drawing:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply also with requirements in other Sections for equipment mounted outdoors.
- 3. All delegated design submittals for seismic- and wind-restraint detail Drawings are to be signed and sealed by qualified professional engineer responsible for their preparation.
- 4. Product Listing, Preapproval, and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and basis for approval (tests or calculations).
- 5. Design Calculations for Vibration Isolation Devices: Calculate static and dynamic loading due to equipment weight and operating forces required to select proper vibration isolators, and to design vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Seismic Qualification Data: Provide special certification for designated seismic systems as indicated in ASCE/SEI 7-10, Paragraph 13.2.2, "Special Certification Requirements for Designated Seismic Systems" for all Designated Seismic Systems identified as such on Drawings or in the Specifications.
 - 1. Provide equipment manufacturer's written certification for each designated active mechanical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7 and AHRI 1270, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction or experience data as permitted by ASCE/SEI 7-10.
 - 2. Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-10.
 - 3. Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by a licensed professional engineer.
 - 4. The following HVAC systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:
 - a. Entire VRF System.
 - b. Ventilation and Energy Recovery System.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct testing indicated, be an NRTL as defined by OSHA in 29 CFR 1910.7, and be acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: an agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01, to design seismic load control system.
 - 1. Seismic Performance: Equipment to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7-10.
- B. Seismic Design Calculations:
 - 1. Perform calculations to obtain force information necessary to properly select seismic-restraint devices, fasteners, and anchorage. Perform calculations using methods acceptable to applicable code authorities and as presented in ASCE/SEI 7-10 including supplement No. 1 or other seismic calculation method required by authorities having jurisdiction.
 - a. Data indicated below to be determined by Delegated Design Contractor must be obtained by Contractor and must be included in individual component submittal packages.
 - b. Building Risk Category: IV.
 - c. Building Site Classification: D.
 - 2. Calculation Factors, ASCE/SEI 7-10, Ch. 13 - Seismic Design Requirements for Nonstructural Components: All section, paragraph, equation, and table numbers refer to ASCE/SEI 7-10 unless otherwise noted.
 - a. Horizontal Seismic Design Force F_p : Calculated by Delegated Design Contractor by ASCE/SEI 7-10, Equation 13.3-1. Factors below must be obtained for this calculation:
 - 1) S_{DS} = Spectral Acceleration: 0.231. Value applies to all components on Project.
 - 2) a_p = Component Amplification Factor: See Drawing Schedule for each component.
 - 3) I_p = Component Importance Factor: See Drawing Schedule for each component.
 - 4) W_p = Component Operating Weight: For each component. Obtain by Delegated Design Contractor from equipment submittal.

- 5) R_p = Component Response Modification Factor: See Drawing Schedule for each component.
 - 6) z = Height in Structure of Point of Attachment of Component for Base: Determined from Project Drawings for each component by Contractor. For items at or below the base, " z " to be taken as zero.
 - 7) h = Average Roof Height of Structure for Base: Determine from Project Drawings by Delegated Design Contractor.
- b. Vertical Seismic Design Force: Calculate by Delegated Design Contractor using method explained in ASCE/SEI 7-10, Paragraph 13.3.1.
- c. Seismic Relative Displacement D_p : Calculate by Delegated Design Contractor using methods explained in ASCE/SEI 7-10, Paragraph 13.3.2. Factors below must be obtained for this calculation:
- 1) D_p = Relative Seismic Displacement that Each Component Must Be Designed to Accommodate: Calculate by Delegated Design Contractor in accordance with ASCE/SEI 7-10, Paragraph 13.3.2.
 - 2) I_e = Structure Importance Factor: 1.5. Value applies to all components on Project.
 - 3) δ_{xA} = Deflection at Building Level x of Structure A: See Drawing Schedule for each component.
 - 4) δ_{yA} = Deflection at Building Level y of Structure A: see Drawing Schedule for each component.
 - 5) δ_{yB} = Deflection at Building Level y of Structure B: See Drawing Schedule for each component.
 - 6) h_x = Height of Level x to which Upper Connection point Is Attached: Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.
 - 7) h_y = Height of Level y to which Upper Connection Point Is Attached: Determine for each component by Delegated Design Contractor from Project Drawings and manufacturer's data.
 - 8) Δ_{aA} = Allowable Story Drift for Structure A: See Drawing Schedule for each component.
 - 9) Δ_{aB} = Allowable Story Drift for Structure B: See Drawing Schedule for each component.
 - 10) h_{sx} = Story Height Used in the Definition of Allowable Drift Δ_a : See Drawing Schedule for each component.
- C. Consequential Damage: Provide additional seismic restraints for suspended HVAC components or anchorage of floor-, roof-, or wall-mounted HVAC components as indicated in ASCE/SEI 7-10 so that failure of a non-essential or essential HVAC component will not cause failure of any other essential architectural, mechanical, or electrical building component.
- D. Fire/Smoke Resistance: Seismic restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by an NRTL in accordance with ASTM E84 or UL 723, and be so labeled.
- E. Component Supports:
1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of a nationally recognized testing agency.
 2. All component support attachments must comply with force and displacement resistance requirements of ASCE/SEI 7-10 Section 13.6.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
2. Source Limitations: Obtain elastomeric isolation pads from single manufacturer.
3. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
4. Size: Factory or field cut to match requirements of supported equipment.
5. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
6. Surface Pattern: Smooth, ribbed, or waffle pattern.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth, ribbed, or waffle pattern.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)

- g. [Vibration Isolation.](#)
- h. [Vibration Mountings & Controls, Inc.](#)
- 2. Source Limitations: Obtain double-deflection, elastomeric isolation mounts from single manufacturer.
- 3. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
- 4. Elastomeric Material: Molded, oil- and water-resistant neoprene rubber, silicone rubber, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
- 2. Source Limitations: Obtain restrained elastomeric isolation mounts from single manufacturer.
- 3. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
2. Source Limitations: Obtain freestanding, laterally stable, open-spring isolators from single manufacturer.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates limit floor load to 500 psig.
8. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)

2. Source Limitations: Obtain restrained-spring isolators from single manufacturer.
3. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases limit floor load to 500 psig.
 - b. Top plate with threaded mounting holes and elastomeric pad.
 - c. Internal leveling bolt that acts as blocking during installation.
4. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
7. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
8. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
2. Source Limitations: Obtain elastomeric hangers from a single manufacturer.
3. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
4. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.8 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. [Ace Mountings Co., Inc.](#)
 - b. [California Dynamics Corporation.](#)
 - c. [Isolation Technology, Inc.](#)
 - d. [Kinetics Noise Control, Inc.](#)
 - e. [Mason Industries, Inc.](#)
 - f. [Vibration Eliminator Co., Inc.](#)
 - g. [Vibration Isolation.](#)
 - h. [Vibration Mountings & Controls, Inc.](#)
2. Source Limitations: Obtain spring hangers from single manufacturer.
 3. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 8. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 9. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 10. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.9 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. [California Dynamics Corporation.](#)
 2. [Kinetics Noise Control.](#)
 3. [Mason Industries, Inc.](#)
 4. [Vibration Eliminator Co., Inc.](#)
 5. [Vibration Isolation.](#)
 6. [Vibration Mountings & Controls, Inc.](#)
- B. Source Limitations: Obtain vibration isolation equipment bases from single manufacturer.
- C. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails to have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- D. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases to have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

2.10 THRUST RESTRAINTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [Ace Mountings Co., Inc.](#)
 2. [California Dynamics Corporation.](#)
 3. [Kinetics Noise Control.](#)
 4. [Mason Industries, Inc.](#)
 5. [Thybar Corporation.](#)
- B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic forces.
- C. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic forces.
- D. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.

- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter-flashed over roof materials.

2.11 SNUBBERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Kinetics Noise Control, Inc.](#)
 - 2. [Mason Industries, Inc.](#)
 - 3. [Vibration Mountings & Controls, Inc.](#)
- B. Source Limitations: Obtain snubbers from single manufacturer.
- C. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be seismically prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17 for 2015 or 2018 IBC.
 - 2. Preset Concrete Inserts: Seismically prequalified in accordance with ICC-ES AC446 testing.
 - 3. Anchors in Masonry: Design in accordance with TMS 402.
 - 4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

2.12 RESTRAINTS - RIGID TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Kinetics Noise Control, Inc.](#)
 - 2. [Loos & Co., Inc.](#)
 - 3. [Vibration Mountings & Controls, Inc.](#)
- B. Source Limitations: Obtain rigid-type restraints from single manufacturer.
- C. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.13 RESTRAINTS - CABLE TYPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. [Kinetics Noise Control, Inc.](#)
2. [Loos & Co., Inc.](#)
3. [Vibration Mountings & Controls, Inc.](#)

- B. Source Limitations: Obtain cable-type restraints from single manufacturer.
- C. Seismic-Restraint Cables: ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.
- D. Restraint cable assembly with cable fittings must comply with ASCE/SEI 19. All cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.14 RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
1. [Cooper B-Line, Inc.](#)
 2. [Kinetics Noise Control, Inc.](#)
 3. [Mason Industries, Inc.](#)
 4. [TOLCO.](#)
- B. Source Limitations: Obtain restraint accessories from single manufacturer.
- C. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod. Non-metallic stiffeners are unacceptable.
- D. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

2.15 POST-INSTALLED CONCRETE ANCHORS

- A. Mechanical Anchor Bolts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-Line, Inc.
 - b. Hilti, Inc.

- c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - 2. Source Limitations: Obtain mechanical anchor bolts from single manufacturer.
 - 3. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.
- B. Adhesive Anchor Bolts:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - 2. Source Limitations: Obtain adhesive anchor bolts from single manufacturer.
 - 3. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.
- C. Provide post-installed concrete anchors that have been prequalified for use in wind-load applications. Post-installed concrete anchors must comply with all requirements of ASCE/SEI 7-10, Ch. 13.
- 1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
 - 2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

2.16 CONCRETE INSERTS

- A. Source Limitations: Obtain concrete inserts from single manufacturer.
- B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC466 testing.
- C. Comply with ANSI/MSS SP-58.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Examine areas and equipment to receive seismic restraint devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 INSTALLATION OF VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICES

- A. Provide vibration-control devices for systems and equipment where indicated in Equipment Schedules or Vibration-Control Devices Schedules, where indicated on Drawings, or where Specifications indicate they are to be installed on specific equipment and systems.
- B. Provide seismic-restraint devices for systems and equipment where indicated in Equipment Schedules or Seismic-Restraint Devices Schedules, where indicated on Drawings, where Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
- C. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.
- D. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- E. Comply with requirements in Division 07 for installation of roof curbs, equipment supports, and roof penetrations.
- F. Equipment Restraints:
 - 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- G. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

H. Ductwork Restraints:

1. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems" and ASCE/SEI 7
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.
4. Select seismic-restraint devices with capacities adequate to carry static and seismic loads.
5. Install cable restraints on ducts that are suspended with vibration isolators.

I. Install seismic-restraint cables so they do not bend across edges of adjacent equipment or building structure.

J. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

K. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

L. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

M. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

N. Mechanical Anchor Bolts:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors to be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Provide flexible connections in piping systems where they cross structural seismic joints and other point where differential movement may occur. Provide adequate flexibility to accommodate differential movement as determined in accordance with ASCE/SEI 7. Comply with requirements in Division 23 for piping flexible connections.

3.5 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT BASES

- A. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03 – Concrete.
- B. Coordinate dimensions of steel equipment rails and bases, concrete inertia bases, and restrained isolation roof-curb rails with requirements of isolated equipment specified in this and other Sections. Where dimensions of these bases are indicated on Drawings, dimensions may require adjustment to accommodate actual isolated equipment.

3.6 ADJUSTING

- A. Adjust isolators after system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 VIBRATION ISOLATION SCHEDULES

- A. Provide vibration isolators and equipment bases for all rotating, piston driven or vibrating equipment in accordance with the following schedules. Selection of equipment isolators shall be based on approved equipment shop drawings.

Base & Isolator Types			
Base Types		Isolator Types	
A	No base, isolators attached directly to equipment.	1	Elastomeric pad.
B	Structural steel rails or base.	2	Elastomeric floor mount or hanger. Use restrained elastomeric mount where seismic restraint is required.
C	Concrete inertia base.	3	Spring floor isolator or hanger.
D	Curb-mounted base.	4	Restrained spring isolator.
		5	Thrust restraint.

Vibration Isolation - Axial Fans, Cabinet Fans															
Fan Size	Fan Static Pressure	RPM	Floor Span												Table Notes
			Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
Up to 22 in. diameter	All	All	A	2	0.25	A	3	0.75	A	3	0.75	C	3	0.75	1,3
Notes: 1. Where equipment manufacturer indicates component cannot be installed directly on individual isolators (type A) provide equipment manufacturer recommended supplemental support (base type).. 2. Select isolator deflection so that resonance frequency is 40 percent or less of the lowest normal operating speed of equipment. Add a 1 in. thick pad (type 1) to the base plate of spring isolators (type 3). 3. To limit undesirable movement, thrust restraints (type 5) are required for all ceiling-suspended and floor-mounted units operating at 2 in. of water or more total static pressure.															

Vibration Isolation - Centrifugal Fans															
Fan Size	Fan Horsepower	RPM	Floor Span												Table Notes
			Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
Up to 22 in. diameter	All	All	B	2	0.25	B	3	0.75	B	3	0.75	C	3	1.5	3,4
Notes:															
1. Increase isolator deflection so isolator stiffness is less than one-tenth the stiffness of the supporting structure, as defined by the deflection due to load at the equipment support.															
2. Select isolator deflection so that resonance frequency is 40 percent or less of the lowest normal operating speed of equipment. Add a 1 in. thick pad (type 1) to the base plate of spring isolators (type 3).															
3. Provide thrust restraints (type 5) for all ceiling-suspended and floor-mounted units operating at 2 in. of water or more total static pressure.															
4. Fans and Air-Handling Equipment: For fans operating under 300 rpm, select isolator deflection so the isolator natural frequency is 40 percent or less than the fan speed. Flexible duct connectors shall be installed at the intake and discharge of all fans and air-handling equipment to reduce vibration transmission to air duct structures. Provide inertia bases (type C) for all class 2 and 3 fans and air handling equipment. Provide thrust restraints (type 5) with same deflection as isolators for all fans and all base-mounted and suspended air-handling equipment operating at 2 in. or more total static pressure. Adjust restraint movement under normal operational static pressures.															

Vibration Isolation - Propeller Fans															
Fan Type	Horsepower and Other	RPM	Floor Span												Table Notes
			Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
Wall-mounted	All	All	A	A	0.25	A	1	0.25	A	1	0.25	A	1	0.25	

Vibration Isolation - Heat Pumps															
Equipment Type	Horsepower and Other	RPM	Floor Span												Table Notes
			Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
Heat Pumps	All	All	A	3	0.75	A	3	0.75	A	3	0.75	A/D	3	1.5	

Vibration Isolation - Condensing Units															
Equipment Type	Horsepower and Other	RPM	Floor Span												Table Notes
			Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
Condensing Units	All	All	A	1	0.25	A	4	0.75	A	4	1.5	A/D	4	1.5	

Vibration Isolation - Packaged Energy Recovery Ventilators, Air Conditioning Units															
Fan Size	Fan HP, Static Pressure	RPM	Floor Span												Table Notes
			Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
All	≤10	All	A	3	0.75	A	3	0.75	A	3	0.75	A	3	0.75	5
	≥15, ≤4 in. SP	Up to 300	A	3	0.75	A	3	3.5	A	3	3.5	C	3	3.5	1,3,4,5
		300 to 500	A	3	0.75	A	3	2.5	A	3	2.5	A	3	2.5	3,5
		501 and up	A	3	0.75	A	3	1.5	A	3	1.5	A	3	1.5	3,5
Notes:															
1. Where available, use of packaged equipment manufacturer internal isolators meeting the above requirements is acceptable. Coordinate with equipment manufacturer. Provide documentation in both equipment submittals and in submittals for this Section. 2. Increase isolator deflection so isolator stiffness is less than one-tenth the stiffness of the supporting structure, as defined by the deflection due to load at the equipment support. 3. Where equipment manufacturer indicates component cannot be installed directly on individual isolators (type A) provide equipment manufacturer recommended supplemental support (base type). 4. Select isolator deflection so that resonance frequency is 40 percent or less of the lowest normal operating speed of equipment. Add a 1 in. thick pad (type 1) to the base plate of spring isolators (type 3). 5. Provide thrust restraints (type 5) for all ceiling-suspended and floor-mounted units operating at 2 in. of water or more total static pressure. 6. Fans and Air-Handling Equipment: For fans operating under 300 rpm, select isolator deflection so the isolator natural frequency is 40 percent or less than the fan speed. Flexible duct connectors shall be installed at the intake and discharge of all fans and air-handling equipment to reduce vibration transmission to air duct structures. Provide inertia bases (type C) for all class 2 and 3 fans and air handling equipment. Provide thrust restraints (type 5) with the same deflection as isolators for all fans and all base-mounted and suspended air-handling equipment operating at 2 in. or more total static pressure. Adjust restraint movement under normal operational static pressures.															

Vibration Isolation - Ducted Rotating Equipment															
Equipment Type	Airflow (cfm)	RPM	Floor Span												Table Notes
			Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
Small fans, fan-powered boxes, fan coil units, cabinet heaters, unit heaters	≤600	All	A	3	0.5	A	3	0.5	A	3	0.5	A	3	0.5	
	≥601	All	A	3	0.75	A	3	0.75	A	3	0.75	A	3	0.75	

3.8 PIPING SYSTEM VIBRATION ISOLATION

A. Vibration isolators for suspended piping:

1. Provide spring hangers for all piping in equipment rooms and up to 50 ft from vibration-isolated equipment. The first three hangers from the equipment shall be provided with the same deflection as the equipment isolators, with a maximum limitation of 2 in. deflection. Remaining hangers shall be spring or combination spring and elastomeric with 0.75 in. deflection. The first two hangers adjacent to the equipment shall be the positioning or pre-compressed type. Provide positioning hangers for all isolated piping 8 in. and larger. Piping over 2 inches in diameter suspended below or within 50 ft of conference rooms, classrooms and auditorium areas shall be hung with isolation hangers.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Perform tests and inspections with the assistance of a factory-authorized service representative.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
3. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
4. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
5. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
6. Test to 90 percent of rated proof load of device.
7. Measure isolator restraint clearance.
8. Measure isolator deflection.
9. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 230548

SECTION 23 05 93
TESTING, ADJUSTING AND BALANCING
TABLE OF CONTENTS

PART 1 - GENERAL 1

1.1 RELATED DOCUMENTS 1

1.2 DESCRIPTION OF WORK 1

1.3 DEFINITIONS 1

1.4 SUBMITTALS 2

1.5 QUALITY ASSURANCE 5

1.6 PROJECT CONDITIONS 6

1.7 SEQUENCING AND SCHEDULING 6

PART 2 - PRODUCTS 6

PART 3 - EXECUTION 6

3.1 GENERAL 6

3.2 PRELIMINARY PROCEDURES FOR AIR SYSTEMS 7

3.3 MEASUREMENTS 8

3.4 PERFORMING TESTING, ADJUSTING, AND BALANCING 8

3.5 BALANCING TOLERANCES 8

3.6 AIR SYSTEM BALANCING 9

3.7 TESTING FOR SOUND AND VIBRATION 12

3.8 RECORD AND REPORT DATA 12

3.9 DEMONSTRATION 12

SECTION 230593 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Related Sections: All Articles of Division 23 apply to this section.

1.2 DESCRIPTION OF WORK

- A. This Section specifies the requirements and procedures for total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design documents and recording and reporting the results. Coordinate readings with Section 23 09 00 Vendors to help calibrate BCS system. Testing, adjusting and balancing of systems shall not begin until the BCS System is complete and functional. All work required in this section shall be performed in conjunction with the work required of the BCS Contractor, not independently.
- B. Demolition of existing HVAC equipment, ductwork, piping, automatic temperature controls and appurtenances.
- C. Test, adjust, and balance the following mechanical systems:
 - 1. All supply air systems.
 - 2. All return air systems.
 - 3. All exhaust air systems.
 - 4. All mechanical equipment.
 - 5. Verify control system operation. (Coordinate with Section 23 09 00)
- D. Test systems for proper sound and vibration levels.
- E. This Section does not include:
 - 1. Specifications for materials for patching mechanical systems.
 - 2. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.
 - 3. Requirements and procedures for piping and ductwork systems leakage tests.

1.3 DEFINITIONS

- A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:
 - 1. The balance of air distribution.
 - 2. Adjustment of total system to provide design quantities.

3. Electrical measurement.
 4. Verification of performance of all equipment and automatic controls.
 5. Sound and vibration measurement.
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling, change pulleys).
- D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
- E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- F. Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.
- G. Terminal: The point where the controlled fluid enters or leaves the distribution system. There are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

1.4 SUBMITTALS

- A. Agency Data:
1. Submit proof that the proposed testing, adjusting, and balancing agency meet the qualifications specified below.
- B. Engineer and Technicians Data:
1. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.
- D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1 and Section 23 05 00.
- E. Sample Forms: Submit sample forms, if other than those standard forms prepared by the AABC or NEBB are proposed.
- F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems.

Follow the procedures and format specified below:

1. Draft reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 3 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 3 complete sets of final reports.
 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - a. General Information and Summary
 - b. Air Systems
 - c. Control Systems
 - d. Special Systems
 - e. Sound and Vibration Systems
 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.
 - b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC and NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- G. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of one month prior to starting the project.
- H. Balancing report shall include as a minimum, the following information (other parts of the specifications may require additional information).
1. Fan Data:
 - a. Manufacturer and model number.
 - b. Airflow, design.
 - c. Airflow, actual.
 - d. Direction of rotation and revolutions per minute.
 - e. Inlet static pressure.
 - f. Discharge static pressure.

- g. Fan curves showing variation of air flow with static pressure at operating speed and motor loading.
 - h. Actual airflow percentage above or below design.
 - i. Fan RPM, design.
 - j. Fan RPM, actual.
 - k. Pulley manufacturer, model number, pitch diameter.
 - l. Belt size and quantity.
- 2. Pump and Compressor Data:
 - a. Manufacturer and model number.
 - b. Flow design.
 - c. Flow actual.
 - d. Direction of rotation and revolutions per minute.
 - e. Inlet pressure.
 - f. Discharge pressure.
 - g. Curves showing variation of flow with pressure for installed unit (1/2 flow, 3/4 flow, and 1 1/4 flow).
 - h. Flow percentage above or below design.
- 3. Motor Data:
 - a. Manufacturer and model number.
 - b. Horsepower.
 - c. Phase.
 - d. Frequency.
 - e. NEMA code letter.
 - f. Rated volts.
 - g. Locked rotor amperes.
 - h. Service factor.
 - i. Measured volts.
 - j. Measured amps.
 - k. Measured frequency.
 - l. Nameplate RPM.
 - m. Actual RPM.
 - n. Pulley manufacturer, model number, pitch diameter.
- 4. Starter Data:
 - a. Manufacturer and model number.
 - b. Heater size.
 - c. Line voltage.
 - d. Ampere rating.
 - e. Control voltage.
 - f. Frequency.
- 5. Air Outlet Data:
 - a. Reproducible floor plan drawings showing all air outlet locations and numbers assigned to outlets for purpose of test.
 - b. Air outlet manufacturer and model number.
 - c. Size.
 - d. Actual free area.
 - e. Manufacturer's test factor.
 - f. Measured velocity.
 - g. Airflow design.

- h. Airflow actual.
- i. Airflow percentage above or below design.
- j. Airflow pattern.

6. Outdoor Air Data:

- a. Size of inlet.
- b. Actual free area.
- c. Manufacturer's test factor.
- d. Measured velocity.
- e. Outdoor air temperature.
- f. Return air temperature.
- g. Mixed air temperature with averaged traverse readings (when at least a 20°F temperature difference exists).

7. Cooling and Heating Elements:

- a. Manufacturer and model number.
- b. Measured water pressure drop.
- c. Water flow design.
- d. Water flow actual.
- e. Water flow percentage above or below design.
- f. Measured air pressure drop.

1.5 QUALITY ASSURANCE

A. Agency Qualifications:

- 1. The testing, adjusting, and balancing agency shall meet the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
- 2. The testing, adjusting, and balancing agency certified by Associated Air Balance Council (AABC) or by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by AABC or NEBB as a Test and Balance Engineer.

B. Codes and Standards: Where the referenced codes and standards conflict, the more stringent requirement shall apply.

- 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".
- 2. AABC: "National Standards for Total System Balance."
- 3. ASHRAE: ASHRAE Handbook, latest edition, Chapter on Testing, Adjusting, and Balancing.
- 4. SMACNA: "HVAC systems testing, adjusting and balancing."

C. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the Construction Manager, Owner's representative and representatives of installers of the mechanical and control systems. The

objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

- D. Testing, adjusting and balancing shall not commence until all systems are complete and functional.

1.6 PROJECT CONDITIONS

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

- A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.
- C. Notify Owner's Representative 14 days before scheduled testing, adjusting, and balancing is to commence.

PART 2 - PRODUCTS

- A. Not Used.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ensure that all contractors and trades whose work and installed systems are under testing and balancing, are present on site during the entire time that these procedures take place. Note that some procedures listed below have a distinct order of precedence, e.g., the testing of Building Control System shall not occur until major pieces of mechanical equipment have been started up and testing is complete. Prepare schedule, order and procedure for testing and balancing, submit to the Owner's Representative (OR) for review and approval.
- B. Testing and balancing shall not diminish guarantee requirements.
- C. Before the procedure begins a meeting shall be held at the site, between the balancing contractor, the BCS contractor, the mechanical contractor and prime contractor. The prime contractor shall present the Owner's Representative (OR) with the completed checklists certifying that equipment startup and testing has been completed. The contractor shall then present his procedures for testing the overall system to OR for review and approval.
- D. When the BCS testing has been completed a second meeting will be held at the site offices between the parties mentioned above. At this time the BCS contractor shall present OR with the completed control startup checklist. The balancing contractor shall present OR with certificates of calibration for balancing instruments, proposed balancing forms and proposed balancing procedures to OR, for review and approval.
- E. Do not cover or conceal work before testing and inspection and obtaining approval.
- F. Instruments for testing and balancing shall have been calibrated within one month prior to testing and calibration. Calibration shall be traceable to NIST Standards. Provide photostat

of certificate of calibration to OR at meeting demonstrating balancing procedures mentioned in this section.

- G. Leaks, damage and defects discovered or resulting from testing, adjusting and balancing shall be repaired or replaced to like-new condition with acceptable materials. Tests shall be continued until system operates without further requirements for adjustments or repairs.
- H. Report on reporting forms, submitted to OR for approval in advance.
- I. For each piece of equipment, copy nameplate data and include in report.
- J. Submit six copies of testing and balancing reports to OR for approval.
- K. Provide capacity and performance of equipment by field testing. Install equipment and instruments required for testing, thermo-wells and gauge connections at no additional costs.
- L. Qualified representative of equipment manufacturer shall be present at test.
- M. Testing, adjusting and balancing procedures outlined below are the minimum effort required for the project. Contractor shall use any additional procedures he feels will be necessary to properly startup, test and balancing the job.

3.2 PRELIMINARY PROCEDURES FOR AIR SYSTEMS

- A. Before operating the system, perform these steps:
 - 1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.
 - 2. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.
 - 3. Compare design to installed equipment and field installations. Ensure discrepancies are shown on the record drawings.
 - 4. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design. Ensure discrepancies are shown on the record drawings.
 - 5. Check filters for cleanliness.
 - 6. Check dampers (control, smoke, volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
 - 7. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
 - 8. Determine best locations in main and branch ductwork for most accurate duct traverses.
 - 9. Place all volume dampers in the full open position. Open appropriate quantity of VAV boxes (if applicable) to simulate air flow diversity.
 - 10. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

11. Lubricate all motors and bearings.
12. Check fan belt tension, adjust as necessary.
13. Check fan rotation, adjust as necessary.

3.3 MEASUREMENTS

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- B. Provide instruments meeting the specifications of the referenced standards.
- C. Use only those instruments, which have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- F. When averaging values, take a sufficient quantity of readings so that the average results in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- G. Take all reading with the eye at the level of the indicated value to prevent parallax.
- H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- I. Take measurements in the system where best suited to the task.

3.4 PERFORMING TESTING, ADJUSTING, AND BALANCING

- A. Perform procedures on each system installed under this contract, in accordance with the detailed procedures outlined in the referenced standards and in these specifications.
- B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- C. Patch insulation, ductwork, and housings, using materials identical to those removed.
- D. Seal ducts and piping, and test for and repair leaks.
- E. Seal insulation to re-establish integrity of the vapor barrier.
- F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- G. Retest, adjust, and balance systems subsequent to system modifications, and resubmit test results.

3.5 BALANCING TOLERANCES

- A. Air Handling and Fan Systems

1. Low and Medium Pressure:
 - a. Fans Design volume + 10%, -5%
 - b. Outlets Design volume +/- 10%
2. Ceiling Filters:
 - a. Individual filter terminals design volume + 5%, -0% (to space served)
 - b. Unidirectional air flow area: Total area - Design volume + 5% variation between individual point velocities and design velocities + 10%.

3.6 AIR SYSTEM BALANCING

- A. Visually inspect all fire, smoke, control and volume dampers on branch take offs to each floor to ensure that they are fully open. Open as necessary (coordinate with the BCS Contractor).
- B. Verify with straight edge that fan and motor shafts are parallel and that sheaves are in proper alignment. Use belt tensioner to confirm belts are at proper tension. Refer to deflection tables appropriate for installed belts. Adjust alignment and tension as necessary.
- C. Start fans and verify that fan rotation is correct. If not, coordinate with electrical contractor to switch power leads such that the fan rotates correctly.
- D. Verify that fan belts are tight on one side and have slight bow on other side when fan is operating with no squeal at startup. If not correct, adjust sheaves or motor base accordingly.
- E. Check nameplate voltage on motor, compare to scheduled voltage. Notify OR immediately of any discrepancies. Measure and record actual voltage across all power leads. Notify OR of discrepancies immediately.
- F. For each variable volume air handling unit do the following:
 1. Add total maximum cfm of all volume boxes shown on drawings.
 2. Divide this total by the maximum cfm scheduled for the unit to get diversity factor. For example, if total box cfm is 50,000 and AHU is scheduled for 40,000 cfm diversity is $40,000/50,000 = 80\%$.
 3. Open the volume boxes necessary to approximate diversity, i.e., in the above example, open the variable boxes to 80% of their design maximum.
- G. Check motor nameplates full load amps, measure and record amperage across all power leads. If there are marked discrepancies in amperage draws between legs, notify OR immediately.
- H. Measure and record fan and motor RPM. Check that motor rpm agrees with nameplate and scheduled rpm.
- I. Perform static pressure profile as follows: Record all results and submit to OR.
 1. Determine static pressure across supply and exhaust fans as follows:
 - a. Measure static or total pressure at fan suction.

- b. Measure static or total pressure at fan discharge.
 - c. Differential is the static pressure developed by fan.
- 2. Determine static pressure:
 - a. Across each filter section.
 - b. Across each coil.
 - c. Across each sound attenuator.
 - d. Across each volume damper at branch take offs to each floor.
 - e. Across each fire damper.
 - f. At up to 15 points, in each supply system (fewer points for each exhaust system) to be selected by OR or to be determined when ductwork shop drawings are approved.
- 3. Determine the correct causes of any excessively high readings, i.e. open/throttled dampers, clean/dirty coils, etc. and make necessary adjustments or coordinate necessary repairs. Seal all holes when measurements are complete. Label locations of measurements and cross reference labeling in report.
- J. For all supply and exhaust systems with filters and volume controls (terminal boxes, or VFD) add static pressure to the system to simulate the effect of dirty filters and wet cooling coils. For all supply and exhaust systems with filters and no volume controls, add static pressure to the system to simulate the effect of 1/2 dirty filters and wet cooling coils. Static (see drawings for exact P.D. of dirty filters and wet coils) shall be added by covering filter section with cheesecloth or other suitable material. Confirm appropriate static pressure has been added with new static pressure reading across filters and fan. Remove cheesecloth, etc. after traverses are complete.
- K. Perform pitot tube traverse of supply, exhaust and return main ducts. **Summing CFM totals from diffusers is not an acceptable method of determining total airflow from AHU's or fans.** Balancing Contractor shall provide and install hardware for test locations and shall properly seal them after tests. Label location of traverses and cross-reference on the report. Perform traverses in accordance with procedures outlined in latest edition of the SMACNA HVAC Testing, Adjusting and Balancing Manual, except that if recommended lengths of straight duct before and after traverse points are not available, increase number of measuring points by 50%. If a 24 point traverse would be called for given the duct cross section area-measure 36 points, for example.
- L. Adjust sheave pulley diameters or replace fixed pitch sheaves as necessary to meet the balancing tolerance of the fan at full speed. Replace belts as necessary.
- M. Measure amperage at each power leg after traverse is complete. If an overload condition exists with measured CFM equal to scheduled CFM, notify OR immediately.
- N. For economizer systems with Section 23 09 00 BCS contractors presence and assistance, adjust minimum and maximum outdoor air CFM to quantities shown on schedules. Place outdoor air dampers in minimum position as adjusted by controls contractor. Measure temperature in mixed air plenum, temperature of outdoor air and by proportioning determine % of outdoor air being supplied. Place outdoor air damper in maximum open position or fully open variable outside air damper and repeat above measurements.

- O. For systems with terminal volume boxes do the following, with BCS Contractor present for necessary coordination:
 - 1. At static pressure probe location in field, with number of space temperature sensors necessary to approximate installed diversity calling for full cooling, measure static pressure with manometer and compare with reading registering at DDC system field panel or CRT. The "most critical" volume box shall be determined by the OR from approved sheet metal shop drawings submittals. Typically the pressure drop from the supply fan outlet to this box inlet is greater than for any other box. Observe damper linkage, at this box, instruct controls contractor to vary static pressure setpoint as required so that with stats calling for full cooling, most critical box damper is 75% open. For units serving areas that are HEPA filtered first simulate a dirty HEPA filter by adding static to filter. (Score line on damper linkage and mark full open and closed positions of box damper. Using protractor mark 75% position open position on volume box.)
 - 2. At each supply terminal volume box, confirm that temperature sensor and box controller are compatible. At each terminal volume box disconnect the actuator's control line and confirm that box damper fails to position called for on control drawings. Confirm second position for two position boxes, confirm room pressurization. Adjust volumes to meet required pressurization in accordance with the control drawings.
 - 3. At each supply variable volume terminal box, set temperature sensor serving box for no cooling. At box test ports take differential pressure reading with a manometer. Adjust box minimum position at controller so that differential pressure reading corresponds to box minimum primary air CFM shown on schedules. Place temperature sensor controlling box to full cooling position. Using manometer gauge adjust box controller maximum position setting to produce differential pressure corresponding to box maximum primary air as shown on schedules. Measure CFM's from all diffusers served by box. Confirm total agrees with scheduled box cfm.
 - 4. Supply boxes with reheat coils, set temperature sensor to call for full heating and confirm that hot water control valve modulates open.
 - 5. At each constant volume terminal box, use manometer to adjust setpoint of box controller to differential pressure corresponding to velocity(s) (airflow) scheduled for box.
 - 6. At each exhaust and return box, use manometer to adjust calibration of controller.
- P. Balance each diffuser, register and grille to within specified tolerances. Follow procedures in SMACNA manual referenced above. For branch ductwork and runouts, one runout in each branch shall have its damper at least 90% open. Ensure proper pressure relationships between adjoining spaces and include in submittal.
- Q. For constant volume systems, perform pilot tube traverses for branch ducts on each floor. Adjust volume dampers to produce design CFM for each branch.
- R. Traverse all exhaust ducts. Adjust as necessary to specified tolerances.
- S. Balance supply air systems in unfinished areas:
 - 1. Supply air systems shall be balanced after installation of items related to same systems with exception of duct taps to air diffusers in interior zones.

2. Balance as required to deliver air volume at outlets within 10% of design flow shown on Drawings.
 3. Provide sufficient temporary openings in interior zone duct systems to adjust interior zone air volumes.
 4. Readjust air volumes after completion and occupancy, as required to properly balance heating and cooling loads throughout conditioned areas.
 - T. Fire Dampers:
 1. Random test 10% of the fire dampers, selected by the OR, for proper operation by applying heat to release fusible links.
 2. After test, replace fusible links and reset dampers.
- 3.7 TESTING FOR SOUND AND VIBRATION
 - A. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.
- 3.8 RECORD AND REPORT DATA
 - A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.
 - B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.
- 3.9 DEMONSTRATION
 - A. Training:
 1. Train the Owner's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Review with the OR's personnel, the information contained in the Operating and Maintenance Data specified in Division 1.
 2. Schedule training with OR with at least 21 days prior notice.

END OF SECTION

SECTION 230600 - HEATING, VENTILATING AND AIR CONDITIONING

TABLE OF CONTENTS

PART 1 - GENERAL	1
1.1 SUMMARY	1
1.2 REFERENCES	3
1.3 QUALITY ASSURANCE	4
1.4 SUBMITTALS	4
1.5 SHEET METAL FABRICATION DRAWINGS	6
1.6 MANUALS AND INSTRUCTIONS	6
PART 2 - PRODUCTS	7
2.1 DUCTWORK AND AIR DISTRIBUTION EQUIPMENT	7
2.2 DUCTWORK, ACOUSTICAL LINING	22
2.3 INSULATION, DUCTWORK	23
2.4 PIPING AND FITTINGS	26
2.5 INSULATION, PIPING	28
2.6 PIPING, HANGERS AND SUPPORTS	30
2.7 MOTORS, STARTERS AND WIRING	31
2.8 DRIVES	34
2.9 FILTER, MEDIUM EFFICIENCY, THROW AWAY TYPE	34
2.10 FILTERS HIGH EFFICIENCY, THROW AWAY TYPE	34
2.11 CABINET HEATERS - ELECTRIC	35
2.12 UNIT HEATERS - ELECTRIC	35
2.13 VIBRATION ISOLATION (NON-SEISMIC AND SEISMIC)	35
2.14 ACCESS PANELS – (WALL AND CEILING MOUNTED)	35
2.15 REMOTELY ADJUSTING BALANCING DAMPER	36
2.16 DUCT COIL - ELECTRIC HEATING	36
2.17 VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS (VRF)	37
2.18 ENERGY RECOVERY VENTILATOR (ERV-1)	45
PART 3 - EXECUTION	47
3.1 REFERENCE	Error! Bookmark not defined.
3.2 SPECIAL RESPONSIBILITIES	47
3.3 TAGS AND VALVE TAG CHARTS	48
3.4 PIPE AND DUCT IDENTIFICATION	48
3.5 EQUIPMENT TESTING	48
3.6 DUCT LEAKAGE TESTS (PRESSURE TESTS)	48
3.7 OEM CONTROLS INTEGRATION	49
3.8 EQUIPMENT START UP	49
3.9 HVAC SYSTEMS DEMOLITION	50

SECTION 23 06 00
HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of this Section is governed by the General Conditions, Supplementary Conditions, Sections in Division 1 and Section 23 05 00 of the Project Manual.
- B. Perform work and provide materials and equipment as shown on Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide complete and fully functional systems installation.
- C. Give notices, file plans, obtain permits and licenses, pay fees and backcharges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with the Contract Documents.
- D. In general, the work of this section shall include, but not be limited to:
 - 1. Access panels.
 - 2. Air system balancing.
 - 3. Air conditioning unit and air cooled condenser.
 - 4. Air distribution system including all pressure classes of ductwork, diffusers, registers, grilles, splitters, dampers, etc.
 - 5. Air flow control valves.
 - 6. Automatic temperature controls, variable air volume controls and other controls.
 - 7. Cleaning.
 - 8. Condensate piping.
 - 9. Condensate pumps
 - 10. Constant volume and variable air volume air handling units, including fans, coils, filters, motors and mixing boxes.
 - 11. Coordination and maintenance of existing services during construction with Owner.
 - 12. Coordination drawings.
 - 13. Ductwork, piping, tanks and equipment insulation.
 - 14. Electric cabinet heaters.
 - 15. Equipment bases and supports.
 - 16. Energy Recovery Ventilator.
 - 17. Fans, supply, exhaust, return, ventilation, miscellaneous, etc.
 - 18. Flexible connections for pumps and other vibrating and rotating equipment.
 - 19. Flexible ductwork.
 - 20. Grilles, registers, and diffusers.
 - 21. Instruction manuals and startup instructions.
 - 22. Insulation materials.
 - 23. Motors.
 - 24. Motor starters.
 - 25. Piping materials.
 - 26. Pressure gauges.
 - 27. Record drawings.
 - 28. Sheet metal work.
 - 29. Sleeves, inserts and hangers.
 - 30. Sound attenuators.
 - 31. Testing and balancing.
 - 32. Thermometers.

- 33. Electric Unit heaters.
- 34. Valves.
- 35. Vibration isolators and inertia blocks.
- 36. VRF system

E. Furnish the following items for installation under other Sections:

- 1. Starters, except starters in Motor Control Centers (MCC) furnished under Division 26 10 00.
- 2. Variable Frequency Drives specified under Section 26 10 00 provided by this Section.
- 3. Access Panels.

F. Related work specified in other Sections includes, but is not necessarily limited to:

- 1. Cutting and Patching: Openings in masonry, concrete, tile, and other parts of structure, except drilling for hangers, providing holes and openings in metal decks, and core drilling.
- 2. Temporary Facilities and Controls: Temporary heat for use during construction.
- 3. Selective Demolition.
- 4. Concrete: Housekeeping pads and inertia pads for vibrating equipment.
- 5. Structural Steel: Equipment supports.
- 6. Metal Fabrications: Structural supports necessary to distribute loading from equipment to roof or floor.
- 7. Flashing and Sheet Metal: Flashing of roof penetrations.
- 8. Firestops and Smoke seals: Caulking of pipe penetrations through floor slabs and fire-rated partitions.
- 9. Metal Flashing and Sheet Metal: Roof and wall penetrations.
- 10. Access Panels: Access to concealed valves, cleanouts, and water hammer arrestors.
- 11. Access Panels.
- 12. Painting: Except as specified herein.
- 13. Acoustical Ceilings: Removal of existing ceilings for new work under this Section.
- 14. Section 23 05 00 - Basic Facility Services Subgroup Requirements.
- 15. Section 23 05 48 - Vibration Isolation and Seismic Control.
- 16. Section 23 09 00 – Building Controls System.
- 17. Section 23 05 93 – Testing, Adjusting and Balancing.
- 18. Section 26 10 00 - Electrical: Power and alarm wiring. Variable frequency drives.

- G. Allowances: Refer to pertinent Sections of Division 1 for description of work under this Section requiring Allowances.
- H. Unit Prices: Refer to pertinent Sections of Division 1 for description of work under this Section requiring Unit Prices.
- I. Alternates: Refer to pertinent Sections of Division 1 for description of work under this Section affected by Alternates.

1.2 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. B9.1: Safety Code for Mechanical Refrigeration
 - 2. B31.5: Refrigeration Code and Heat Transfer Components
- B. American Refrigeration Institute (ARI)
 - 1. 360: Commercial and Industrial Unitary Air Conditioning Equipment
 - 2. 430: Central Station Air Handling Units
 - 3. 575: Method of Measuring Machinery Sound within Equipment Space
- C. Air Moving and Conditioning Association (AMCA)
 - 1. Standard 500: Test Methods for Louvers, Dampers and Shutters
 - 2. Standard 500D: Laboratory Methods for Testing Dampers for Ratings
 - 3. Standard 511: Certified Ratings Program for Air Control Devices
- D. American Society of Mechanical Engineers (ASME)
 - 1. B31.1: Power Piping
- E. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - 1. Standard 52: Gravimetric and Dust Spot Procedures for Testing and Cleaning Devices Used in General Ventilation for Remaining Particulate Matter
 - 2. Standard 15: Safety Code for Mechanical Refrigeration
- F. American Society for Testing and Materials (ASTM)
 - 1. E-84: Test for Surface Burning Characteristics of Building Materials
 - 2. E-477: Standard Method of Testing Duct Liner
 - 3. E-814: Test Method for Fire Tests of Through-Penetration Fire Stops
 - 4. E90: Laboratory Measurements of Airborne Sound Transmission of Building Partitions
 - 5. E413: Classification for Rating Sound Insulation
 - 6. C423-66: Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
- G. Institute of Electrical and Electronic Engineers
 - 1. Standard 112: Standard Test Procedures for Polyphase Induction Motors and Generators
 - 2. RS 232: Set of Standards Specifying Three Types of Interfaces – Electrical, Functional and Mechanical

- 3. RS 485: Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.
- 4. RJ11: A Six Conductor Modular Jack that is Typically Wired to Four Conductors

- H. National Electric Manufacturers Association (NEMA)
 - 1. Standard MG.1 Motors and Generators

- I. Cooling Tower Institute (CTI)
 - 1. Standard 201 Certification Standard for Commercial Water Cooling Towers

- J. Adhesives and Sealant Council (ASC)
 - 1. Standard ASC-A-7001A Adhesive Standard for Duct Liner

- K. Underwriters Laboratories (UL)
 - 1. No. 900: Test Performance for Air Filter Units
 - 2. No. 723: Test for Surface Burning Characteristics of Building Material
 - 3. No. 1479: Fire Tests for Through-Penetration Firestops
 - 4. Fire Resistance Directory

- L. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
 - 1. HVAC Duct Construction Standards
 - 2. HVAC Air Duct Leakage Test Manual
 - 3. Fibrous Class Duct Construction Standards
 - 4. Ducted Electric Heat Guide for Air Handling Systems

- M. National Fire Protection Association (NFPA)
 - 1. No. 70: National Electric Code (NEC)
 - 2. No. 72: National Fire Alarm Code
 - 3. No. 90A: Installation of Air Conditioning and Ventilation Systems
 - 4. No. 90B: Installation of Warm Air Heating and Air Conditioning Systems
 - 5. No. 101: Life Safety Code
 - 6. No. 255: Surface Building Characteristics of Building Materials

1.3 QUALITY ASSURANCE

- A. Qualifications: Use adequate numbers of skilled, licensed workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.
- B. Substitutions: Comply with pertinent Sections of Division 1.
- C. All materials and work provided shall be in accordance with most recent editions of applicable standards and publications of the organizations referenced above.

1.4 SUBMITTALS

- A. Comply with the pertinent provision of Sections in Division 1 and Division 23.

- B. Organization of Shop Drawings: Submit shop drawings and product data submittals in bound packages organized and titled to match the Articles of Part 2 as specified in this Section.
- C. Submit shop drawings and/or product data submittals for all materials and equipment specified in Part 2 of this Section.
- D. Submit sheet Metal Fabrication Drawings.
- E. Submit equipment start-up and commissioning reports.
- F. Submit duct pressure testing report.
- G. Submit record drawings in accordance with the pertinent provisions of Division 1 for Project Record Documents and Division 23.
- H. Submit copies of the Operation and Maintenance Manuals in compliance with the requirements of Division 1 as specified for Contract Close-Out requirements, Division 23, and the additional requirements of this Section.
- I. Prepare and submit shop drawings, O&M manuals and perform training as indicated on the following matrix.

Products	Shop Dwgs.	O&M Man.	Spare Parts List	Training
ACCESS PANELS	√			
ACOUSTICAL DUCT LINING	√			
CABINET UNIT HEATERS	√	√	√	
CARBON MONOXIDE AND DIOXIDE DETECTION AND ALARM SYSTEM	√	√	√	√
CONDENSATE PUMPS	√	√	√	√
CONTROL SYSTEM	√	√	√	√
DAMPERS AND SPLITTERS	√	√	√	
DIFFUSERS, REGISTERS AND GRILLES	√			
DUCTWORK	√			
ENERGY RECOVERY VENTILATOR				
FANS	√	√	√	
FILTERS	√			
FLEXIBLE DUCT	√			
FLEXIBLE DUCT CONNECTIONS	√			
HANGERS AND SUPPORTS	√			
HORIZONTAL PROPELLER UNIT HEATERS	√	√	√	
INSULATION	√			

Products	Shop Dwgs.	O&M Man.	Spare Parts List	Training
MOTORS, DRIVES AND STARTERS	√	√	√	√
REFRIGERANT PIPING AND ACCESSORIES	√	√	√	
SHEET METAL ACCESS PANELS	√			
SOUND ATTENUATORS	√			
THERMOMETERS	√			
VALVES	√	√	√	
VRF SYSTEM	√	√	√	
VIBRATION ISOLATORS AND SEISMIC RESTRAINTS	√	√	√	√
WALL PENETRATION CLOSURES	√			

1.5 SHEET METAL FABRICATION DRAWINGS

- A. Definition: Sheet Metal fabrication drawings are the installation shop drawings normally prepared by the installing sheet metal sub-contractor.
- B. Coordination Drawings: Prepare sheet metal fabrication drawings in accordance with the requirements for coordination drawings as specified in Division 23.
- C. Submit sheet metal fabrication drawings for review after all coordination with specialty trades is completed. Drawings shall show the following:
 - 1. Ductwork including sizes and elevations.
 - 2. Duct fittings, transitions and takeoffs.
 - 3. Equipment including terminal boxes, coils, diffusers, grilles, fans, air handling units, air flow stations, and sound attenuators.
 - 4. Volume, fire, smoke, and automatic control dampers.
 - 5. Duct smoke detectors.
 - 6. Duct access doors.

1.6 MANUALS AND INSTRUCTIONS

- A. Operation and Maintenance Manuals: Prepare manuals in compliance with the pertinent requirements of Division 1 Section regarding Contract Close-Out Issues, Division 23 and the additional requirements of this Section. In addition to the requirements of other Sections, each manual shall include:
 - 1. Product data cut sheets and approved shop drawings for equipment and materials as specified in this Section.
 - 2. Lubrication instructions.
 - 3. Equipment Start-Up and Commissioning Reports.

- B. Instruction Seminar: Perform systems instruction seminar and walk-through with the Owner's Representatives after preparation and review of the Operations and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 DUCTWORK AND AIR DISTRIBUTION EQUIPMENT

A. Reference Standards

1. Material, construction and installation shall meet requirements of most recent editions of the following standards and references, except for more stringent requirements specified or shown on Drawings:

Standard	As Applicable to
SMACNA HVAC Duct Construction Standards (Metal and Flexible)	Sheet Metal Ductwork; Duct Liners; Adhesives; Fasteners; Flexible Ductwork.
SMACNA HVAC Air Duct Leakage Test Manual	Duct Leakage Testing
SMACNA Fibrous Glass Duct Construction Standards	Fibrous Glass Ductwork; Tapes
SMACNA Ducted Electric Heat Guide for Air Handling Systems	Electric Duct Heaters
NFPA 90A	Fire Dampers; Fire Resistance Standards for Ducts and Liners

B. General

1. There shall be no tags or labels installed inside of ductwork.
2. Provide supporting and hanging devices necessary to attach entire HVAC system including ductwork and equipment, and to prevent vibration.
3. Provide vertical and horizontal supports as required by codes to meet minimum applicable earthquake resistance standards.
4. Ductwork shall be free from vibration under all conditions of operation. Dimensions shown on Drawings for lined ductwork are net inside dimensions. Increase ductwork to accommodate lining requirements.
5. Pipe or conduit crossing duct:
 - a. No pipe, conduit, hanger, Architectural element nor structural member shall pass through duct without Architect's written approval.
 - b. Where it is impossible to re-route pipe or conduit and when written approval has been obtained, increase duct size to maintain constant cross-sectional area at point of interference. Provide streamlined enclosure for pipe or conduit, as illustrated in SMACNA.

6. When making offsets and transitions necessary to accommodate structural conditions, preserve full cross-sectional area of ductwork shown on Drawings.
7. Ductwork shall have pressure-velocity classifications as follows:

Duct Construction Class	Static Pressure Rating	Pressure	SMACNA Seal Class	SMACNA Leakage Class	Velocity
10"	10"	Pos.	A	3	2000 fpm or greater
6"	6"	Pos.	A	3	2000 fpm or greater
4"	4"	Pos.	A	3	4000 fpm or less
3"	3"	Pos. or Neg.	A	3	4000 fpm or less
2"	2"	Pos. or Neg.	A	6	2500 fpm or less
1"	1"	Pos. or Neg.	A	6	2500 fpm or less
1/2"	1/2"	Pos. or Neg.	A	6	2000 fpm or less
For negative pressures less than -3" w.g., refer to SMACNA Round and Rectangular Industrial Duct Construction Standards for joint and intermediate reinforcement requirements.					
For round ductwork, negative pressures less than -2" wg, refer to SMACNA round industrial duct construction standards and build to negative 4" wg minimum.					

8. Ductwork shall have pressure-velocity classifications as follows:

Duct Construction Class					
Duct Construction Class	Static Pressure Rating	Pressure	SMACNA Seal Class	SMACNA Leakage Class	Velocity
10"	10"	Pos.	A	6	2000 fpm or greater
6"	6"	Pos.	A	6	2000 fpm or greater
4"	4"	Pos.	A	6	4000 fpm or less
3"	3"	Pos. or Neg.	A	6	4000 fpm or less
2"	2"	Pos. or Neg.	B	12	2500 fpm or less

1"	1"	Pos. Neg.	or B	12	2500 fpm or less
1/2"	1/2"	Pos. Neg.	or B	12	2000 fpm or less
For negative pressures less than -3" w.g., refer to SMACNA Round and Rectangular Industrial Duct Construction Standards for joint and intermediate reinforcement requirements.					

- a. Unless otherwise specified or shown on the drawings, the following pressure classifications shall be used for the types of ductwork listed below:

4" (POS) Class: All supply ductwork from discharge of air handling units to inlets of terminal volume boxes.

4" (NEG and POS): Minimum pressure class for smoke control system ductwork. Ducts will be tested at 100% pressure class and 1.5 times maximum design pressure. Increase pressure classification to be greater than 1.5 design pressure.

2" Class: All other ductwork.

9. Sealing Requirements for Class A, Leakage Class 3, Galvanized, Non-Welded Aluminum or Non-Welded Stainless Steel Ductwork:

a. Transverse Joints

- 1) During assembly seal all flanged transverse joints with sealing tape of quality equal to Hardcast Inc. 1902-FR. Corners shall be sealed as described by SMACNA and when applicable per manufacturer's published procedures. After sealant has cured, seal entire joint with Hardcast Inc. RTA-50 adhesive onto Hardcast Inc. DT tape or approved equal.
- 2) Seal all non-flanged transverse joints with Hardcast Inc. RTA-50 adhesive onto Hardcast Inc. DT tape or approved equal.

b. Longitudinal Seams

- 1) Seal all longitudinal seams during ductwork fabrication with Ductmate PROseal or Hardcast Inc. Cold Seal 1001.

c. Joints and Ductwall Penetrations

- 1) Seal all duct joints at takeoffs, access doors, damper bearing penetrations, flexible duct connections etc., with Ductmate PROseal or Hardcast Inc. Versa Grip 102.
- 2) Note, access doors and damper rod penetrations shall be equipped with proper hardware for sealing.

10. Sealing Requirements for Class A, Leakage Class 6, Galvanized, Non-Welded Aluminum or Non-Welded Stainless Steel Ductwork
 - a. Transverse Joints
 - 1) During assembly seal all flanged transverse joints with sealing tape Hardcast Inc. 1902-FR. Corners shall be sealed as described by SMACNA and when applicable per manufacturer's published procedures.
 - 2) Seal all non-flanged transverse joints with Ductmate PROseal or Hardcast Inc. Versa Grip 102.
 - b. Longitudinal Seams
 - 1) Seal all longitudinal seams during ductwork fabrication with Ductmate 5511M or Hardcast Inc. Cold Seal 1001.
 - c. Joints and Ductwall Penetrations
 - 1) Seal all duct joints at takeoffs, access doors, damper bearing penetrations, flexible duct connections etc., with Ductmate PROseal or Hardcast Inc. Versa Grip 102.
11. Sealing Requirements for Class B, Leakage Class 12, Galvanized, Non-Welded Aluminum or Non-Welded Stainless Steel, Ductwork
 - a. Transverse Joints
 - 1) During assembly seal all flanged transverse joints with sealing tape Hardcast Inc. 1902-FR. Corners shall be sealed as described by SMACNA and when applicable per manufacturer's published procedures.
 - 2) Seal all non-flanged transverse joints with Ductmate PROseal or Hardcast Inc. Versa Grip 102.
 - b. Longitudinal Seams
 - 1) Seal all longitudinal seams during ductwork fabrication with Ductmate 5511 M or Hardcast Inc. Cold Seal 1001.
12. Support
 - a. Hang and support ductwork as defined in Section 4 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible" Second Edition or as defined within.
 - b. Supports, bar/angle reinforcements and other products that are not part of the duct that are manufactured of uncoated mild steel shall either be painted with two coats of primer or shall be manufactured of a galvanized equivalent material.
 - c. Hanger spacing not to exceed 8 feet.
 - d. Support vertical duct on each floor or slab it penetrates.

- e. Hanger assemblies located the garage area and areas exposed to the weather, including; anchors, clamps, threaded rod, nuts, washers and pipe hanger shall be provided with a factory applied hot dipped galvanized coating. Any components or assemblies that require field modification, cutting, welding, or removal of the applied hot dipped galvanized coating shall be repainted with the appropriate coating.

13. Connections

- a. Connect inlets and outlets of air handling units and fans to ductwork with flexible connections unless fan has vibration isolator mounts inside unit with flexible connections and no external vibration isolators. Exception: Do not use flex on life safety smoke exhaust fans.
- b. Indoors, flexible connections shall be neoprene-coated fibrous glass fire retardant fabric, by Ductmate, Ventfabrics, or Durodyne. Outdoors, flexible connections shall be Dupont hypalon-coated fibrous glass fire-, weather-, and UV-resistant by Ductmate, Ventfabrics or Durodyne.
- c. Secure flexible connections tightly to air handlers with metal bands. Bands shall be same material as duct construction.
- d. Connections from trunk to branch ducts shall be as detailed on Drawings.

14. Construction

- a. No sharp metal edges shall extend into air streams.
- b. Install drive slips on air-leaving side of duct with sheet metal screws on 6" centers.
- c. Spin in collars shall NOT be used.

15. Joints

- a. Longitudinal lock seams shall be double-locked and flattened to make tight joints.
- b. Make transverse joints, field connections, collar attachments and flexible connections to ducts and equipment with sheet metal screws or bolts and nuts. Do not use rivets and staples.
- c. Round Joints
 - 1) Construct ducts in accordance with Section 3 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible" Second Edition.
 - 2) Round ducts shall be spiral seam construction except where noted.
 - 3) Up to 20" diameter: Interior slip coupling beaded at center and fastened to duct with screws shall be used to join ducts. Seal joint with an approved sealing compound, continuously applied around joint prior to assembling and after fastening, making certain that majority of sealant resides on interior of the joint.

- 4) 21" – 72" diameter: Install using a three-piece gasketed flanged-joint consisting of two internal flanges, with integral mastic sealant, and one external closure band, which compress the gasket between the internal flanges. Approved systems: Ductmate Spiralmate.
- 5) Above 72" diameter: Install using companion angel flanged joints as defined in Figure 3-2 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible", Second Edition. Refer to manual for proper sizing and construction details. Duct wall to be welded longitudinal seams.

16. Prefabricated Transverse Duct Joints

- a. Slide-On Transverse Joint Connectors: Prefabricated slide-on transverse duct connectors and components will be accepted. Duct constructed using prefabricated systems will refer to the manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and proper joint reinforcement(s). Approved connection systems: Ductmate Industries or W.D.C.I or approved equal.
- b. Formed-On Flanges: Formed-on flanges – T-25A (T.D.C.) or T-25B (T.D.F.) will be accepted. Formed-on flanges will be accepted for use on ductwork 42" wide or less and subjected to 2" static positive pressure or less. Formed-on flanges will be constructed as T-25 A/B flanges, of which the construction guidelines are given in Figure 1-4 of the 1995 SMACNA "HVAC Duct Construction Standards, Metal and Flexible". No other construction standards pertaining to formed-on flanges will be accepted. Formed-on flanges must include the use of corners, bolts, cleat and gasket.
- c. Angles shall be at least 20 gauge. Prefabricated transverse duct joints shall not be used for duct 16 gauge and heavier, nor for duct 23 gauge or lighter.
- d. Secure angles to duct with screws (using clutched arbor) or spot-welds spaced as recommended by manufacturer for duct pressure class.

17. Elbows and Bends

- a. Elbows and bends for rectangular ducts shall have radiused heels and (where possible) throats and shall have centerline radius of 1.5 times duct width wherever possible. Elbows for grease exhaust and fume hood exhaust shall be full radius. Square heeled elbows, turning vanes, or mitered elbows are not allowed.
- b. Where centerline radius is less than 1.5 times duct width (on supply, return and exhaust ductwork), elbows shall be radius throat with radius heel and full length splitter vanes when required. Minimum inside radius (not centerline) shall be 2". Install vanes in accordance with SMACNA. When centerline radius (r) divided by the duct width (w) is less than 1.5, provide the following number of splitter vanes:

r/w	No. of Vanes
0.7 to 01.49	1
0.6 to 0.69	2

0.55 to 0.59	3

- c. For round ductwork provide stamped elbows, with centerline radii equal to 1-1/2 times duct diameter, or gored elbows as follows:

Angle	Gores
0 -36	2
37 -72	3
73 -90	5

- d. Elbows for flat oval ducts shall have centerline radii equal to 1-1/2 times duct diameter in plane of bend, or gored elbows with gores as specified for round ducts.

18. Duct Mounted Access Panels/Doors

- a. Provide proper pressure and leakage rated, gasketed, duct mounted access panels/doors. In insulated ducts, access doors shall be insulated double wall. Gauges of door materials, no. of hinges, no. and type of door locks shall be as required by the SMACNA Duct Construction Standards. Unhinged doors shall be chained to frame with a minimum length of 6" to prevent loss of door. For seal Class A, hinged doors are not acceptable, screwed or bolted access panels are not acceptable. Access doors shall be leakage rated, neoprene gasketed UL 94 HF1 listed, DUCTMATE "Sandwich." Door metal shall be the same as the attached duct material. For grease and high temperature ducts, door assembly shall be rated for 2300 degrees F. The minimum sizes are:
- 1) Fire dampers - 12" x 12", or larger.
 - 2) Automatic control dampers - 6" x 6" minimum.
 - 3) Manual volume dampers 2 SF and larger - 6" x 6" minimum.
 - 4) Inlet side to all coils - 12" x 12", or larger.
 - 5) Suction and discharge sides of inline fans - 24" x 24" minimum.
 - 6) At additional locations indicated on drawings, or specified elsewhere - 12" x 12" minimum.
 - 7) Flow measuring stations - 12" x 12" or larger.
 - 8) Provide access door for all supply air ductwork upstream and downstream of each elbow and tee and at intervals of approximately 40 ft. to allow maximum reach of 20 ft. in straight horizontal runs for cleaning - 24" x 24" unless duct size is smaller in which case largest size possible shall be used (min. 6" x 6").
- b. Access doors are not shown on the drawings, but shall be provided in accordance with the above.

19. Plenums and connections to louvers:
 - a. Shall be 18 ga. minimum cross-broken and properly reinforced with galvanized angle irons to SMACNA requirements.
 - b. Shall have bottom and corner seams soldered watertight at least 12" up from bottom.
 - c. Shall have neoprene gaskets or other non-corrodible material to make connections to louvers watertight.
 - d. Shall pitch connection back towards the louver. Provide half-coupling drain connection at bottom of plenum unless noted otherwise. Pipe drain to nearest floor drain.
 - e. Shall have unused portions of louvers blocked-off with sheet metal; sealed air- and water-tight; insulated with 2" thick 6-lb. density rigid or board insulation.
20. Materials
 - a. Sheet metal ducts shall be constructed of hot-dipped galvanized sheet metal with G60 or G90 Commercial coating according to ASTM A653/A653M and A924/A924M unless specified otherwise. G60 shall not be used where exposed to industrial pollutants, marine atmosphere or contact with moisture.
 - b. Aluminum ductwork shall be Alclad 3003-1414 or alloy 5052-H32, of thickness required by the SMACNA duct construction standards.
21. Flexible Ductwork
 - a. Flexible ductwork, connecting to uninsulated or unlined duct, shall be vinyl coated fiberglass cloth 0.0057" minimum thickness, 25 strands per inch minimum thread count with corrosion-resistant helical wire reinforcement. Flex duct shall be U.L. rated for 12" W.C. positive pressure, 2" W.C. negative pressure with a maximum velocity of 4000 FPM. Flexduct must be listed as a Class 1 Connector according to UL 181 and shall meet the requirements of NFPA 90A - maximum ASTM E-84 fire hazard rating shall be 25 flame spread, 50 fuel contributed and 50 smoke developed. Flexible duct shall be equivalent to Flexmaster Type 4.
 - b. Flexible duct connected to insulated or lined duct shall be insulated with 1-1/2", 1/2 lb. density fiberglass insulation and flame retardant (UL Listed) vapor barrier, meeting ASTM E-84 rating.
 - c. Submittals shall include data on core, in addition to other data listed above required to ensure that submitted product meets the requirements of these specifications.
 - d. Provide sealing compound and draw bands for installation. See further paragraphs in this specification, and details for other installation requirements.
 - e. Flexible ductwork connecting to uninsulated or unlined duct shall be Flexmaster Triple Lock UL181 Class 0 for bare duct, Class 1 for

insulated duct. Duct shall be UL rated for 12" W.C. positive pressure, 2" negative pressure.

- f. Flexible duct shall be airtight, triple lock mechanically spiral formed with spiral corrugation. Material shall be 3003 zero temper aluminum, .0065" minimum thickness.
- g. Flexible duct connected to insulated or lined duct shall be insulated with 1-1/2", 1/2 density fiberglass insulation and flame retardant (UL Listed) vapor barrier, meeting ASTM E-84 rating.
- h. Submittals shall include data on core, in addition to other data listed above required to ensure that submitted product meets the requirements of these specifications.
- i. Provide sealing compound and draw bands for installation. See further paragraphs in this specification, and details for other installation requirements.
- j. Provide supports at manufacturer's recommended intervals. Sag shall not exceed 1/2" per foot of spacing between supports. Ducts shall not exceed 6 feet long and shall be used for straight run only, no offsets or turns.
- k. Hanger and saddle in contact with flexible duct shall be wide enough to prevent restriction of internal duct diameter when weight of supported section rests on hanger or saddle material.
- l. Factory-installed suspension systems integral to flexible duct are acceptable as alternative hanging method when manufacturer's recommended procedures are followed.
- m. Collars to which flexible ducts are attached shall be at least 2" long. Sleeves for joining sections of flexible duct shall be at least 4" long.
- n. Runouts from ducts to inlet connections of air terminal boxes, except fan boxes, shall not be flexible duct.
- o. Apply sealing compound to metallic surface at connection of flexible duct with sheet metal ducts, collars and mixing boxes. Slip flexible ductwork over sealing compound. Complete seal with commercially-made draw bands.

- 22. Provide factory fabricated round or oval ductwork and fittings as manufactured by United Sheet Metal Company, Semco or Lindab or approved equal.

C. 2" and Lower Pressure Class Metal Ductwork – Rectangular

- 1. Ducts wider than 19" with more than 10 square feet of unbraced panel shall be beaded or cross-broken.
- 2. Internal stiffening struts shall only be used upon prior written approval of the Architect.
- 3. Make changes in duct size with tapered connections as required by SMACNA. Changes shall NOT exceed 30 from line of air flow. Take-off to the diffusers shall be 45 leading edge type or Bellmouth type.

4. Transverse joints shall be TDF/TDC or slip joints; use flat or standing seam according to SMACNA. Where duct size requires standing seam, but space restrictions dictate flat seam, notify Architect prior to fabrication.
- D. 2" and Lower Pressure Class Metal Ductwork – Round
1. Joints
 - a. Longitudinal joints shall be spiral seam, butt welded, lap and seam welded, or ACME lock-grooved seam. Snap lock seams shall be used on 1/2" w.g. pressure class duct only.
 - b. Transverse joints shall be beaded sleeve joint or other approved joints listed in SMACNA. Use three or more sheet metal screws at 15" uniform intervals along circumference of joints.
 2. Branch fittings shall be conical tee (Buckley or equal) or combination tee as shown in SMACNA.
- E. 3" and 4" Pressure Class Metal Ductwork – Rectangular
1. Joints
 - a. Joints shall be prefabricated type by TDC, TDF or Ductmate. See Prefabricated Joints paragraph for specific requirements.
 2. Duct reinforcement spacing and type shall comply with SMACNA.
 3. Ductwork on both sides of transitions shall be run in same horizontal axis.
 4. Diverging section slope shall be 1-1/2" per foot or less if possible.
 5. Contraction section slope shall not exceed 7" per foot.
 6. Takeoffs shall be 45 leading edge type except that Bellmouths (Buckley or equal) may be used for takeoffs to terminal boxes if the distance between the box and point of takeoff is less than 8 ft.
 7. Ducts with an aspect ratio greater than 3:1 shall be minimum of 18 gauge unless a thicker gauge is required by SMACNA.
- F. 3" and 4" Pressure Class Metal Ductwork - Round - Single Wall
1. Joints
 - a. Longitudinal seams shall be lock spiral, lock longitudinal or butt welded longitudinal.
 - b. Transverse joints shall be slip joints. Draw band joints shall be used on longitudinal seam duct only. Loose flange Ductmate Spiralmate or Vanstone joints may be used on ducts over 36" in diameter.
 - c. Seams and joints in fittings shall be continuously welded. If coating is damaged during welding, repair joints to prevent corrosion.
 2. Branch fittings shall be conical tee or combination tee as detailed in SMACNA.

G. Fibrous Glass Duct Board Ductwork

1. Provide Certain-teed, Knauf, Owens Corning or Manville heavy duty or approved equal, E1-800, fibrous glass duct board with foil and kraft facing where shown on Drawings. Duct board shall be 1" thick with maximum K-factor of 0.23 and 0.75 noise reduction coefficient. Board edges shall form molded slip joints. Insulation shall meet manufacturer's requirements.
2. Fibrous glass duct board ductwork shall meet requirements of SMACNA Fibrous Glass Duct Construction Standard, NFPA 90A and 90B and UL-181.
3. Fabrication and installation of duct and fittings including closure systems for longitudinal seams and transverse joints shall meet requirements of latest edition of SMACNA Fibrous Glass Duct Construction Standard.
4. Joints shall be stapled and sealed with (manufacturer's heat activated strip) (SMACNA-registered pressure sensitive tape).

H. Static Fire Dampers

1. Provide fire dampers throughout air supply system as shown on Drawings and as required by applicable codes, standards and authorities. Provide access door for each fire damper of sufficient size to repair internal link (see access panel/door section).
2. Ratings
 - a. Fire Resistance
 - 1) Dampers shall have a UL 555 resistance rating of 1-1/2 hours in barriers with fire resistance fire rating less than 3 hours.
 - 2) Dampers shall have a UL 555 fire resistance rating of 3 hours in barriers with fire resistance ratings of 3 hours or more.
 - b. Fire Closure Temperature: Each fire damper shall be equipped with a factory installed heat responsive device (fusible link) rated to close the damper when temperature at the damper reaches:
 - 1) 165°F
 - 2) 212°F
3. Static Fire Damper Construction
 - a. Frame: Galvanized steel (in gauges required by manufacturer's UL listing).
 - b. Sleeves: Damper shall be supplied as a single assembly with an integral factory sleeve.
 - c. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.
 - d. Blades: Galvanized curtain style. Damper blades shall be out of the air stream.

- e. Closure Device: Fusible link (replaceable).
 - f. Where duct passes through fire walls or partitions, the spaces around the fire damper sleeves shall have the necessary clearance for expansion in conformance with the UL approval. Installation shall conform to all UL-555 requirements.
 - g. Use of dampers shall NOT reduce net free area of duct.
 - h. Dampers shall be installed per SMACNA with breakaway connections and nose pieces on duct liner (see SMACNA HVAC Duct Construction Standards).
 - i. Install dampers in accordance with manufacturer's UL Installation Instructions, labeling, and NFPA 90A at locations indicated on the drawings.
 - j. Dampers must be accessible to allow inspection, adjustment, and replacement of components. Furnish any access doors in ductwork or plenums required to provide this access. Furnish any access doors required in walls, ceilings or other general building construction.
 - k. Install dampers square and free from racking.
 - l. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Install support mullions as reinforcement between assemblies as required.
 - m. Do not compress or stretch the damper frame into the duct or opening.
4. Fire dampers shall be Air Balance, Greenheck, Ruskin, Nailor Industries or Prefco.
- I. Curtain Type Dynamic Fire Dampers
- 1. Provide fire dampers throughout air supply system as shown on Drawings and as required by applicable codes, standards and authorities. Provide access door for each fire damper of sufficient size to repair internal link (see access panel/door section).
 - 2. Ratings
 - a. Fire Resistance
 - 1) Dampers shall have a UL 555 resistance rating of 1-1/2 hours in barriers with fire resistance fire rating less than 3 hours.
 - 2) Dampers shall have a UL 555 fire resistance rating of 3 hours in barriers with fire resistance ratings of 3 hours or more.
 - b. Fire Closure Temperature: Each fire damper shall be equipped with a factory installed heat responsive device (fusible link) rated to close the damper when temperature at the damper reaches:

- 1) 165°F
 - 2) 212°F
 - c. Differential Pressure
 - 1) Dampers shall have a minimum UL 555 differential pressure rating of 4 in. wg.
 - d. Velocity
 - 1) Dampers shall have a minimum UL 555 velocity rating of 2000 fpm.
3. Dynamic Fire Damper Construction
- a. Frame: Galvanized steel (in gauges required by manufacturer's UL listing).
 - b. Sleeves: Damper shall be supplied as a single assembly with an integral factory sleeve.
 - c. Retaining angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.
 - d. Blades: Galvanized curtain style. Damper blades shall be out of the air stream.
 - e. Closure Device: Fusible link (replaceable).
 - f. Where duct passes through fire walls or partitions, the spaces around the fire damper sleeves shall have the necessary clearance for expansion in conformance with the UL approval. Installation shall conform to all UL-555 requirements.
 - g. Use of dampers shall NOT reduce net free area of duct.
 - h. Dampers shall be installed per SMACNA with breakaway connections and nose pieces on duct liner (see SMACNA HVAC Duct Construction Standards).
 - i. Install dampers in accordance with manufacturer's UL Installation Instructions, labeling, and NFPA 90A at locations indicated on the drawings.
 - j. Dampers must be accessible to allow inspection, adjustment, and replacement of components. Furnish any access doors in ductwork or plenums required to provide this access. Furnish any access doors required in walls, ceilings or other general building construction.
 - k. Install dampers square and free from racking.
 - l. Do not compress or stretch the damper frame into the duct or opening.
 - m. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator or jackshaft.

4. Fire dampers shall be Air Balance, Greenheck, Ruskin, Nailor Industries or Prefco.

J. Volume Dampers

1. Provide manual adjustable volume dampers, with extended mount indicating and locking quadrants:
 - a. On each supply, return and general exhaust duct take-off.
 - b. At each take-off to register, grille or diffuser (not all are shown on drawings).
 - c. As indicated on details on drawings.
2. For Seal Class A, penetrations shall be provided with sealed assemblies, Ventlok HVEL 641 and HVEL 609 end bearing or approved equal. For insulated ducts provide proper assembly.
3. Dampers shall be 1/2" smaller in both dimensions or 1" smaller diameter than size of duct in which they are installed; e.g., use 23-1/2" by 23-1/2" damper for 24" square duct.
4. Dampers larger than 12" in height shall be opposed multi-blade as manufactured by Air Balance, Greenheck, Ruskin and Nailor or approved equal. Below 12" in height as manufactured by Durodyne, Titus and Young or approved equal.
5. Damper blades shall be two gauges heavier than adjoining ductwork, and shall be riveted to supporting rods. Hem over edges parallel to rods.
6. Brackets shall be galvanized metal, secured to ductwork with sheet metal screw with locking quadrant arms (see seal class section for additional requirements). Provide 2" handle extension for all dampers on externally insulated ductwork.
7. Volume dampers are not necessarily shown on the plans, but dampers shall be provided as necessary for system balancing.

K. Gravity Backdraft Dampers

1. Backdraft dampers shall have 12 ga. galvanized steel channel frame with 14 ga. galvanized press formed steel sub frame and 16 ga. reinforced galvanized steel blades with edge seals. Dampers shall be designed for velocities up to 3,500 FPM.
2. Counter-balance arms shall be 2 x 1/4 x 12" long hot rolled steel bar external to damper. Counter-weights shall be 2" diameter hot rolled steel bar attached to counter-balance arms. Axles shall be 1/2" diameter cadmium plated steel continuous rods with 1/2" diameter ball bearings. Dampers shall have plated steel center brackets; brass pivots; 5/16" plated steel linkage rod. Provide linkage on panels 31" to 48" wide. Damper shall have all welded construction.
3. Dampers shall be as manufactured by Vent Products (Model 3200) or equivalent by American Warming and Ventilating, Air Balance or Ruskin or approved equal.

L. Automatic Dampers: Install automatic dampers furnished under Automatic Temperature Control Section, as shown on Drawings, and as specified. Provide sealed penetrations for Seal Class A ductwork.

M. Diffusers, Registers and Grilles

1. Provide (aluminum) (steel) diffusers, registers and grilles for supply, return and exhaust outlets, of size, type and design shown on Drawings. Acceptable manufacturers shall be Nailor, Tuttle & Bailey (Agitair), Titus or approved equal.
2. Equipment shall be tested and rated per ASHRAE 91-70.
3. Equipment shall handle air quantities at operating velocities:
 - a. With maximum diffusion within space supplied or exhausted.
 - b. Without objectionable air movement as determined by Architect.
 - c. With sound pressure level not to exceed NC 30.
4. Supply registers shall have two sets of directional control blades.
5. Diffusers within same room or area shall be of same type and style to provide Architectural uniformity.
6. Surface mount diffusers, registers and grilles shall be furnished with gaskets and installed with faces set level and plumb, tightly against mounting surface.
7. Finish shall be as directed by Architect.
8. Coordinate diffusers, registers and grilles with ceiling and wall construction. Refer to Architectural Drawings for exact lengths and for framing and mitering arrangements that may differ from those shown on HVAC Drawings.

N. Shower Exhaust Ductwork

1. Shower exhaust ductwork shall be stainless steel or aluminum, Seal Class A construction with matching metal volume dampers and Ventlok Hivel 641 and 609 seals.

O. Air Flow Traverse Stations

1. Provide airflow traverse stations at each AHU main supply duct, each supply and exhaust shaft serving the building, and any other locations that may be shown on the drawings.
2. Traverse stations shall be connected to ductwork with bolts at flanges; stations shall be removable for cleaning. Each probe mounted within the station shall contain multiple total and static pressure sensors placed at equal distances (for rectangular ducts) or at concentric area centers (for circular ducts). The number of sensors provided with each flow station shall comply with the ASHRAE standards for duct traversing. The airflow traverse station shall produce a steady non-pulsating flow signal without need for correction factor or special calibration. The station shall be capable of measuring airflow through the station to within 2% of actual flow.
3. The probes shall be installed perpendicular to the velocity profile gradient.
4. Traverse probes or stations which incorporate honey comb grid or tube type airflow straighteners are not acceptable.
5. Traverse stations shall be constructed out of the same type material as the duct material.

6. Traverse stations shall be Voluprobe/1 by Air Monitor, Inc.
7. Provide for each station a Magnehelic gauge by Dwyer Inc. Gauges shall have dual scales calibrated in both CFM and FPM increments. Gauge face scale shall be matched to duct cross section and CFM involved. Gauge must be calibrated for actual areas. For fan inlets, the shafts and bearing areas must be subtracted if applicable. Mount gauge vertically on ductwork next to traverse station. Provide two Dwyer A-313 vent valves for each gauge to allow gauges to be removed from connecting tubing. Connect vent valves to traverse stations with copper tubing as shown on detail - Do Not Crimp Tubing.
8. All traverse stations must be shown on the sheet metal shop drawings. This requirement will be strictly enforced by the Architect.

2.2 DUCTWORK, ACOUSTICAL LINING

- A. Provide 1" thick acoustical lining by Certainteed, Knauf, Owens Corning or Manville for following ductwork:
 1. Supply and return air ductwork, including plenums, for minimum of 20 feet from air handling units (or to sound attenuator if attenuator is located further than 20' from fan). Exception: 3 feet before and 20 feet after humidifiers (use external wrap); and dedicated life safety smoke exhaust systems.
 2. Exhaust ductwork, including plenums, for minimum of 20 feet from fans. Exceptions: kitchen hood, dishwasher, shower exhaust, and fume hood system.
 3. Low pressure duct downstream from variable and constant volume boxes.
 4. Sound attenuation boots.
 5. Ductwork indicated as lined on Drawings.
- B. Increase duct dimensions to accommodate lining while maintaining inside clear dimensions shown on the drawings.
- C. Lining shall be as follows:

Lining for	Material	Minimum NRC	Maximum K-Factor at 75 F Mean
½", 1", 2" Class ductwork (positive or negative)	Black, matfaced, 2 pound density, flexible glass	0.75	0.24

1. For all lined ductwork at the inlets and outlets of fans, and for all lined medium and high pressure ductwork (including plenums) within 20 feet from AHU's provide a perforated 24 gauge aluminum or 28 gauge galvanized steel liner, with 28% minimum free area on the side of the liner exposed to the moving airstream. Metal liner shall be held in place by weld pins spaced no more than 12" O.C.
- D. Materials and installation shall meet following standards, as applicable:
 1. NFPA-90A, UL723, NFPA-255

2. SMACNA Duct Liner Applications Standard
 3. SMACNA Mechanical Fasteners Standard
 4. Adhesive and Sealant Council: Adhesives Standard for Duct Liner - ASC-A-7001A
 5. ASTM E-84 fire hazard classifications of 25 flame spread, 50 smoke developed, and 50 fuel contributed.
- E. Duct liner shall be installed without interruptions or gaps, using 100% coverage of adhesive and mechanical fasteners. Mechanical fasteners shall be welded or secured mechanically to duct on 12" maximum centers.
- F. Cut liner to ensure overlapped and compressed longitudinal joints at corners. Transverse joints in liner shall abut precisely. Seal joints against fiber entrainment with approved adhesive, as recommended by manufacturer. Use sheet metal nosing at beginning of lining (in direction of flow) to minimize erosion.
- G. The contractor shall ensure the integrity of acoustical lining when slip in duct heaters are installed; loose lining shall not flap about in the airstream. Secure edges of lining with sheet metal nosing, where liner is interrupted to make room for the slip in heaters.
- H. Submit samples and catalog data for duct liner, mechanical fasteners, and adhesive to Architect for approval.
- I. Friction coefficient correction factor at 1000 FPM shall be no greater than 1.1. Liner shall be Certain-teed Ultra Liner, Knauf Duct Liner M or Manville Linacoustic or approved equal. Other liners from these manufacturers with friction coefficient correction factors greater than listed above, are not acceptable.
- J. Mylar used for vapor barrier shall meet ASTM E-84 classification.
- K. Any cut liner due to duct takeoffs and branches shall be totally sealed at edges (with sheet metal nose pieces) to prevent entrainment of loose fibers.

2.3 INSULATION, DUCTWORK

- A. General
1. Insulation shall be Certain-Teed, Knauf, Johns-Manville or Owens Corning. Install insulation, mastics, adhesives, coatings, covers, weather-protection and other work exactly as required by manufacturer's recommendations. Materials shall meet requirements of Adhesive and Sealant Council Standards and SMACNA.
 2. Apply insulation after systems have been tested, proved tight and approved by Architect. Remove dirt, scale, oil, rust and other foreign matter prior to installation of insulation.
 3. Leaks in vapor barrier or voids in insulation will not be accepted.
 4. ASTM E-84 minimum fire hazard ratings shall be 25 flame spread, 50 fuel contributed and 50 smoke developed.
 5. Where ducts are insulated, flexible connections to ducts shall be insulated.

6. Insulate standing seams with same material and thickness as duct.
7. Acoustically lined ductwork shall not be insulated externally, except as noted otherwise.
8. Return ductwork in ceiling plenums shall not be insulated.
9. Insulation shall be continuous through wall and ceiling openings and in sleeves.
10. Transmission rates of vapor barriers shall not exceed 0.02 perms.
11. Do not insulate fibrous glass duct.

B. Concealed Rectangular, Flat Oval and Circular Ductwork

1. Insulate supply and fresh air ducts and plena in concealed spaces and return duct not in ceiling plenum with at least 1-1/2" thick fibrous glass duct wrap, with foil-kraft flame resistant vapor barrier.
2. Insulation density shall be 3/4 lb/cf and maximum K-factor shall be 0.30 at 75 deg. F mean temperature.
3. If insulation does not have precut lap make lapped, butt joints by cutting 2" strip of insulation away from vapor barrier. Apply 6" strips of approved adhesive on 16" centers and wrap duct with insulation. Staple lapped joint with outward-clinching staples. Seal stapled joints airtight with approved vapor barrier mastic or pressure-sensitive tape.
4. For rectangular duct 24" or larger in any dimension, augment application method specified in item 3 with approved mechanical fasteners, such as weld pins with speed washers, on 18" centers on bottom of duct.
5. Cover breaks in vapor material with patches of same material, secured with adhesive and staples. Seal staples with approved vapor barrier coating.
6. Fill voids in insulation at jacket penetrations and seal with vapor barrier coating.
7. Seal and flash terminations and punctures with fibrous glass cloth between two coats of vapor barrier coating.
8. Terminate vapor barrier and extend insulation at standoff brackets.

C. Exposed Rectangular Ductwork

1. Insulate exposed supply, return and fresh air ducts and exposed plena with 1" thick, semi-rigid fibrous glass boards with factory-applied fire retardant foil-reinforced kraft vapor barrier facing.
2. Insulation density shall be 3 lb./cf with maximum K-factor of 0.23 at 75 deg. F mean temperature.
3. Impale insulation on mechanical fasteners applied to duct surface on 12" centers. Use at least two rows of fasteners on each side of duct. Provide fastener rows within 3" of seams and edges. Secure insulation with suitable speed washers or clips firmly embedded in insulation. Provide additional fasteners as necessary on cross-broken ducts.

4. Extend insulation to standing seams, reinforcing, and other vertical projections 1" and less; do not carry over. Vapor barrier jacket shall be continuous across seams, reinforcing and projections. Insulation and jacket shall be carried over projections that exceed insulation thickness.
5. Transverse joints shall be butted tightly. Longitudinal joints shall be butted, ship-lapped or 45 mitered. Seal joints with 4" wide strips of approved vapor barrier patch material and adhesive, or with approved pressure sensitive vapor barrier tape.
6. Cover breaks, ribs and standing seam penetrations with patch of jacket material no less than 2" beyond break; secure with adhesive and staple. Seal staples and joints with brush-coat of vapor barrier coating.
7. Fill voids in insulation at jacket penetrations and seal with vapor barrier coating.
8. Seal and flash-terminations and punctures with fibrous glass cloth between two coats of vapor barrier coating.
9. Terminate vapor barrier and extend insulation at standoff brackets.

D. Exposed Round and Flat Oval Ductwork

1. Exposed supply, return and fresh air ducts and exposed plena shall be insulated with at least 1-1/2" fibrous glass ductwrap with foil-kraft flame resistant vapor barrier.
2. Insulation density shall be 3/4 lb/cf and maximum K-factor shall be 0.30 at 75 deg. F mean temperature.
3. If insulation does not have precut lap make lapped, butt joints by cutting 2" strip of insulation away from vapor barrier. Apply 6" strips of approved adhesive on 16" centers and wrap duct with insulation. Staple lapped joint with outward-clinching staples. Seal stapled joints airtight with approved vapor barrier mastic or pressure-sensitive tape.
4. Cover breaks in vapor material with patches of same material, secured with adhesive and staples. Seal staples with approved vapor barrier coating.
5. Fill voids in insulation at jacket penetrations and seal with vapor barrier coating.
6. Seal and flash terminations and punctures with fibrous glass cloth between two coats of vapor barrier coating.
7. Terminate vapor barrier and extend insulation at standoff brackets.
8. Cover with fibrous glass cloth embedded between two coats of suitable waterproof coating. Total dry film thickness shall be 1/8".
9. Cover insulation with 6 oz./sq. yd. canvas coat adhered with approved fire-retardant lagging adhesive.

2.4 PIPING AND FITTINGS

A. General

1. Pipe materials and fitting materials shall be as indicated in Schedule of Pipe and Fitting Materials. Provide dielectric fittings to connect different piping materials.
2. Pipe takeoffs shall have no less than three elbow swings.
3. Solder for copper pipe shall be 95/5 tin/antimony. Lead solder shall not be used.

B. Special Requirements for Water

1. Equipment condensate drains shall be trapped at equipment connection. Drain lines shall run full size of drain tapping to nearest floor drain or as shown on Drawings with a pitch of 1" in 20 feet.
2. Pitch water piping upwards and condensate pump discharge downward in direction of flow 1" in 40 feet, unless otherwise noted.

C. Special Requirements for Refrigerant Piping:

1. Refrigerant piping shall be cleaned, dehydrated and capped for refrigerant service conforming to ASTM B280. All fittings shall conform to ANSI B16.22. All joints shall be made using a brazing alloy containing silver or using a copper-phosphorous alloy. Brazing alloys shall have a minimum of 1,100 degrees F melting temperature and shall conform to ASTM B260.
2. Hangers for refrigerant piping shall be 1A band type of copper plated steel.
3. Install all refrigerant piping in accordance with the requirements of ASHRAE Standard B31.5, Refrigerant piping, ASHRAE Standard 15-1992, Standard Safety Code for Mechanical Refrigeration and all federal, state and local codes.
4. All refrigerant piping shall be installed to ensure that all oil returns to the compressor. Suction line piping shall be sized on a pressure drop between the evaporator and the compressor equal to an equivalent temperature of not greater than 2 degrees F, with a velocity in the vertical rise of not less than 1,000 FPM. Hot gas line piping shall be sized for 3 psig drop between the compressor and the evaporator. Liquid line piping shall be sized on a pressure drop not to exceed 5 psig.
5. Test refrigerant system for leaks with halide torch. After leaks have been made tight, thoroughly dehydrate system and charge with Refrigerant. Be responsible for any leakage of refrigerant during first year of operation and replace any refrigerant lost.
6. Adjust the refrigeration system (head pressure control valve and the condenser pressure differential valve to maintain a constant pressure at the refrigerant receiver. Adjust the) liquid expansion valve and hot gas regulator to maintain a relatively constant suction temperature at all entering air conditions of operation and therefore, a constant discharge air temperature leaving the cooling coil.
7. Provide all pilot operated expansion valves, liquid (and hot gas) solenoid valves, (hot gas regulators), (side connectors for each coil distributor for hot gas bypass), (adjustable head pressure control valve, condenser differential pressure valve, refrigerant receiver), strainers, sight glasses with moisture indicators, silica gel

dryers, purge valves, relief valves, service valves, shut off valves and all other accessories and appurtenances to provide a complete and properly functioning refrigerant system under all conditions of operation. Provide sufficient valves to enable system to be pumped down.

8. Side connector at each coil distributor shall be a Sporlan Type ASC. Hot gas bypass valve shall be a Sporlan Type ADRPE.
9. Refrigerant service valves shall be designed for use with refrigerant used and shall have pressure ratings compatible with system working pressure encountered. Valves shall be packed, wing cap, non-rotating swivel seat disk valves as manufactured by either Henry or Mueller.
10. Check valves shall be brass body suitable for refrigerant liquid or gas service as required by the system design operation. Valves shall be as manufactured by either Henry or Mueller.
11. Filter dryer in the liquid line shall consist of a steel cylinder filled with a suitable desiccant that will not plug, cake, rust, channel or break down and shall remove both water and acid from the refrigerant. The dryer shall be constructed so that none of the desiccant will pass into the refrigerant lines. The filter dryer shall be replaceable core type "Catch-All" as manufactured by either Sporlan or Alco.
12. Sight glasses shall be see through type with cover cap on each side. Sight glasses shall be provided in liquid line before each expansion valve. Sight glasses shall be "See All" combination moisture and liquid indicator as manufactured by either Sporlan or Alco.

D. Schedule of Pipe and Fitting Materials

Service	Pipe Weight	Material	For Type of Joints	Fitting Material	Pressure Rating psi swp. or Weight
Condensate drain	Copper	Type L	Soldered	Copper	125
Refrigerant	Copper	Type ACR	Brazed Copper	Wrought	200
Heating hot water 2" and under	Steel Schedule 40 or Copper	40 or	Screwed Iron 95/5 Solder	Malleable Copper	150 125

E. Connections

1. Provide dielectric fittings at connections of dissimilar materials.
2. Provide eccentric reducing couplings to bring pipes flush on top for water service and flush on bottom for steam service.
3. Branch lines in welded piping shall be made with welding tees except that branch lines less than one-half diameter of main may be made with Weld-O-Lets.
4. Nipples shall be same material, make and thickness as pipe with which they are used. Close nipples shall not be used.

5. Make piping connections 2-1/2" diameter and larger to valves and equipment with flat face welding neck flanges for pressures 125 psig and less raised face for pressures above 125 psig.
6. Make piping connections 2" dia. and smaller to valves and equipment with 300 psi brass seat unions on steel piping and with heavy semi-flushed brass unions on copper tubing.
7. Fit flanged joints with Johns-Manville or approved equal ring gaskets. Flanges shall be faced and drilled to ASA standards and fitted with semi-finished hexagon machine bolts and nuts of proper number and size.
8. Make screw joints tight with Teflon (polytetrafluoroethylene) tape for water or litharge-glycerin mixture for steam applied to male threads. Use tapered threads.
9. Make fusion welded joints as required by ANSI B31.1. Make changes in direction of welded pipe with welded fittings only. Bevel connections before welding, mechanically or by flame-cutting.

2.5 INSULATION, PIPING

- A. Provide pipe insulation manufactured by Owens Corning, Certain-Teed, Johns-Manville or Knauf.
- B. Insulation shall be fibrous glass insulation with factory-applied fire retardant vapor barrier jacket with K factor of at least 0.23 at 75 deg. F mean temperature.
- C. ASTM E-84 fire hazard ratings shall be 25 flame spread, 50 smoke developed and 50 fuel contributed.
- D. Apply insulation after systems have been tested, proved tight and approved by Architect. Remove dirt, scale, oil, rust and foreign matter prior to installation of insulation.
- E. No leaks in vapor barrier or voids in insulation will be accepted.
- F. Insulation and vapor barrier on piping which passes through walls or partitions shall pass continuously through sleeve, except that piping between floors and through fire walls or smoke partitions shall have space allowed for application of approved packing between sleeves and piping, to provide firestop as required by NFPA. Seal ends to provide continuous vapor barrier where insulation is interrupted.
- G. Insulate flexible connections to same thickness and with same material as adjoining pipe insulation.
- H. Provide fibrous dual temperature insulation with factory applied vapor barrier jacket on steam, outdoor condenser water, outdoor cooling tower drain and make up, condensate, chilled water, drain, hot and cold water piping, unless noted otherwise.
- I. Provide PVC jacket covers over all pipe insulation located under raised floors.
- J. Cooling coil condensate drain piping and outdoor cooling tower drain piping shall have 3/4" thick insulation. Insulation thickness for indoor steam, steam condensate, chilled water, hot water and cold water piping shall be as follows:

Minimum Pipe Insulation Thickness							
Fluid Operating Temperature Range (°F) and Usage	Insulation Conductivity		Nominal Pipe or Tube Size (in)				
	Conductivity Btu in./(h ft ² °F)	Mean Rating Temperature, °F	<1	1 to <1-1/2	1-1/2 to <4	4 to <8	≥8
Hot Water Systems							
>350°F	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251°F – 350°F	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201°F – 250°F	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
141°F – 200°F	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105°F – 140°F	0.22 – 0.28	100	1.0	1.0	1.5	1.5	1.5
Cooling Systems (Chilled Water, Brine and Refrigerant)							
40°F – 60°F	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
<40°F	0.20 – 0.26	50	0.5	1.0	1.0	1.0	1.5

- K. Insulation on steam relief lines and general below-ground (not buried) steam and condensate piping of pressures greater than 10 psig shall be 11 lb./cu. ft. density, molded hydrous calcium silicate fastened with 16 gauge annealed wire on 18" centers. Exposed covering shall be finished with 8 oz. canvas jacket.
- L. Insulation for prefabricated piping specified in Preinsulated Piping Paragraph shall be cellular glass of 1-1/2" thickness for chilled water and 2-1/2" for hot water, Foamglass by Pittsburgh Corning with maximum K-factor of 0.35.
- M. Provide longitudinal lap and 6" wide vapor barrier joint seal strips secured with approved adhesive.
- N. Seal ends of pipe insulation and seal insulation to pipe with approved fire retardant vapor barrier, at flanges, valves and fittings and at intervals of no more than 21 feet on continuous runs of piping.
- O. Secure covers on concealed pipe with metal bands at least 3/4" wide and no more than 18" apart, spaced to hold ends and centers of each section.
- P. Insulate all refrigerant suction piping with 1-1/2 inch thick and all refrigerant hot gas piping with 3/4 inch thick and all condensation drainage piping with 3/4 inch thick flexible elastomeric thermal piping insulation similar and equal to Armaflex AP Pipe Insulation that meets 25 Flamespread and 50 Smoke-Developed ratings as tested by ASTM E84-89. All joints, slits and seams shall be sealed with Armstrong 520 contact adhesive to provide a continuous vapor seal. Coat all insulation that is exposed or that is outdoors with two coats of Armstrong Armaflex Coating to provide a protective finish.
- Q. Outdoor Pipe Insulation and Waterproofing (Water Service Only, not for steam or steam condensate).
1. Provide 1" thick flexible unicellular elastomeric foam rubber tubing insulation by Armstrong (Armaflex), Manville, Owens Corning or Halstead/Nomaco (Insultube) or approved equal, with maximum K-factor of 0.27. Install as recommended by manufacturer.
 2. Insulate valves and fittings with same thickness insulation as pipe using manufacturer's preformed fitting and valve insulation or field-fabricated covers made with manufacturer's templates.
 3. Adhere insulation to pipe and seal butt joints with full coverage of insulation manufacturer's approved adhesive.
 4. Apply two coats of finish material to insulation.

5. Apply two coats of approved vinyl lacquer coating over woven glass yarn mesh adhered to insulation surface with Insulcolor or approved equal lagging adhesive.
 6. Provide cork or dowel supports and metal shields at pipe hangers and supports as recommended by manufacturer.
- R. Piping outdoors or underground shall be waterproofed with 45 lb. glazed roofing felt, as follows:
1. Orient laps to shed water.
 2. Wire in place with 16 gauge annealed copper wire at 9" on center.
 3. Provide 4" butt joint strips and secure with two wire ties.
- S. Refrigeration Line Insulation
1. Suction lines, hot gas bypass lines, and outdoor liquid lines shall be insulated with 3/4" thick rigid closed cell foam insulation, Armstrong Rigid Armaflex, Manville, Owens Corning or Halstead/Nomaco (Insultube), except in computer room plena.
 2. Installation shall meet manufacturer's recommendations. Seal butt joints with insulation manufacturers approved adhesive.
 3. Outside above ground insulation shall be protected with two coats of approved vinyl lacquer coating over woven glass mesh adhered to insulation with Insulcolor or approved equal lagging adhesive, as recommended by manufacturer.
 4. Refrigerant piping in hung ceiling and underfloor supply and return plena shall be insulated with 1" thick fibrous glass insulation that meets applicable requirements of this Paragraph.

2.6 PIPING, HANGERS AND SUPPORTS

- A. Provide pipe stands, supports, hangers and other supporting appliances as necessary to support work required by Contract Documents.
- B. Secure vertical piping to building construction to prevent sagging or swinging.
- C. Space hangers for horizontal piping as follows:

Nom. Pipe Size (inches)	Max. Span (feet)	Min. Rod Size (inches)	Hanger Type
1-1/4 and Smaller	7	3/8	Clevis Hanger
1-1/2	9	3/8	Clevis Hanger

- D. Horizontal copper tubing shall have maximum hanger spacing of 5 ft. for tubing 1-1/4" dia. and smaller and 10' for tubing 1-1/2" and larger. Maximum spacing for PVC pipe hangers shall be 4'.
- E. Reduce spacing, regardless of pipe size, as necessary for fittings, valves and other concentrated loads.

- F. Hangers shall be by Carpenter and Patterson, F & S, or Grinnell Co. Figure numbers of Carpenter and Patterson are specified to establish standards of quality for performance and materials.
- G. Provide spring hangers with travel stops as specified in Vibration Isolation Paragraph of Section 23 05 48 and where shown on Drawings.
- H. Hangers for horizontal lines shall be vertically adjustable to obtain pitch requirements of Piping Paragraph.
- I. Hanger assemblies located the garage area and areas exposed to the weather, including; anchors, clamps, threaded rod, nuts, washers and pipe hanger shall be provided with a factory applied hot dipped galvanized coating. Any components or assemblies that require field modification, cutting, welding, or removal of the applied hot dipped galvanized coating shall be repainted with the appropriate coating.

2.7 MOTORS, STARTERS AND WIRING

- A. Provide motors and controls. Furnish starters for HVAC equipment. Provide control and other related wiring including interlocks. Power wiring (to panelboards, disconnect switches, starters and motors) will be provided under Section 26 10 00, ELECTRICAL. Starters that are not integral to equipment will be furnished under this Section 23 06 00 and installed and wired under Section 26 10 00, ELECTRICAL.
- B. Unless otherwise specified, motors shall be NEMA Design B, constant speed, self-ventilated squirrel cage induction. Motors shall have 1.15 service factor unless totally enclosed. Motors shall have Class B insulation.
 - 1. Motors under 1/2 HP, shall be designed for 120 V, 60 Hz, single phase, unless otherwise specified.
 - 2. Motors 1/2 HP and over shall be as required in schedules.
- C. Motors for use with variable frequency drives (VFD's) shall be "inverter-duty" or "drive duty" motors, compatible with the drive to which it is connected. Use of the motor with a VFD shall not adversely affect the operation, useful life, or warranty of the motor. Motors listed in the schedules to be powered by VFD shall conform to the following:
 - 1. Motors shall have Class F or H insulation.
 - 2. Motor windings shall be spike resistant to withstand 1,600 peak volts.
 - 3. Motors used with VFD shall have a minimum three (3) year warranty.
 - 4. Motor shall be equipped with shaft grounding system.
 - 5. If the motor is located more than 50 feet away from the VFD it serves, the contractor shall provide an output filter on the VFD.
- D. All motors shall be premium efficiency type. They shall conform to NEMA Standard MG-1-12.53a and shall have their efficiencies determined in accordance with IEEE Standard 112 Method B. The NEMA nominal efficiency shall be listed on the motor nameplate. Minimum nominal efficiencies shall be according to the tables below:

TABLE I
PERFORMANCE DATA for ENERGY EFFICIENT MOTORS
DRIP-PROOF TYPE

Minimum Efficiency at Full Load (percent)			
HP	1200 RPM	1800 RPM	3600 RPM
	Eff.	Eff.	Eff.
1	82.5	85.5	80.0
1.5	86.5	86.5	85.5
2	87.5	86.5	86.5
3	89.5	89.5	86.5
5	89.5	89.5	89.5
7.5	91.7	91.0	89.5
10	91.7	91.7	90.2
15	92.4	93.0	91.0
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	94.1	93.0
40	94.1	94.1	93.6
50	94.1	94.5	93.6
60	95.0	95.0	94.1
75	95.0	95.0	94.5
100	95.0	95.4	94.5
125	95.4	95.4	95.0
150	95.8	95.8	95.4
200	95.4	95.8	95.4

TABLE II
PERFORMANCE DATA for ENERGY EFFICIENT MOTORS
TOTALLY ENCLOSED FAN COOLED TYPE
Minimum Efficiency at Full Load
(percent)

HP	1200 RPM	1800 RPM	3600 RPM
	Eff.	Eff.	Eff.
1	82.5	85.5	78.5
1.5	87.5	86.5	85.5
2	88.5	86.5	86.5
3	89.5	89.5	88.5
5	89.5	89.5	89.5
7.5	91.7	91.7	91.0
10	91.7	91.7	91.7
15	92.4	92.4	91.7
20	92.4	93.0	92.4
25	93.0	93.6	93.0
30	93.6	93.6	93.0
40	94.1	94.1	93.6
50	94.1	94.5	94.1
60	94.5	95.0	94.1
75	95.0	95.4	94.5
100	95.4	95.4	95.0
125	95.4	95.4	95.4
150	95.8	95.8	95.4
200	95.8	96.2	95.8

- E. Starters that require interlocks or remote control shall be magnetic with HAND-OFF-AUTOMATIC switch (fast-slow-off-auto for two speed motors) in cover. Provide magnetic starters as necessary, with auxiliary contacts, buttons and switches in required configurations. Refer to specification section AUTOMATIC TEMPERATURE CONTROLS and to Control Drawings for interlock requirements. Starters shall be by single manufacturer: Cutler-Hammer, Clark, Arrow Hart or Square D.
- Each 3-phase, 60 Hz motor shall be provided with combination starters with thermal magnetic circuit breakers with either ON-OFF push button or hand-off-automatic switch.
 - Other motors shall be provided with a manual starter with ON-OFF switch.

3. Control relay for each starter shall be for operation on 120 V, single phase, and transformer of sufficient capacity within starter case shall be furnished for this purpose.
4. Provide inverse time limit overload and under voltage protection in each leg and with pilot lights. Provide red and green On-Off pilot lights.
5. Provide nameplates with engraved white lettering to designate area and equipment served.
6. Starters for refrigeration machines shall be furnished by unit manufacturer.
7. Provide starters for two-speed motors with deceleration relay.
8. Furnish for all single speed motors, 10 HP and above, 95% power factor correction capacitors. Capacitors shall be in NEMA enclosure of the same rating as the motor's starter.
9. Furnish reduce voltage starters for all 3 phase motors, 20hp and above.
10. Starters shall be furnished as combination magnetic and circuit breaker type, non-reversing (unless otherwise noted). Each combination starter shall be rated 65,000 symmetrical amperes at 480V.

2.8 DRIVES

- A. Drives for belted motors shall be flame retardant and by Allis-Chalmers, Browning or Woods V-belt drives with adjustable motor sheave. Drives shall be as short as practical and shall have number of belts necessary to transmit required horsepower without undue slip or strain.
- B. Sheaves shall be balanced statically and dynamically.
- C. Hazardous exhaust drives shall be 2 groove (2 belt) minimum.

2.9 FILTER, MEDIUM EFFICIENCY, THROW AWAY TYPE

- A. Do not operate systems without design filters. Provide a new set of filters before the balancing is performed.
- B. Filters shall be Farr or AAF, as scheduled on Drawings. Filters shall be listed by Underwriters Laboratories, Class 2, and rated at a minimum efficiency reporting value (MERV) of 8% per ASHRAE 52-99.
- C. Filter media shall be bonded to an enclosed beverage board frame. The media shall be of non-woven cotton, which is laminated to a welded wire grid, and have an average efficiency of 25-30% by ASHRAE test standard 52-76. Filter area shall be not less than 11 pleats per lineal foot for 4" thick or 15 pleats per lineal foot for 2" thick filter.
- D. Filters shall be listed by Underwriters Laboratories as Class 2.

2.10 FILTERS HIGH EFFICIENCY, THROW AWAY TYPE

- A. Filters shall be AAF or Farr Riga Flo of the sizes and quantities shown on the drawings.
- B. Each filter shall consist of high loft micro fine glass fiber media, which has a non-woven backing and is laminated to a welded wire grid. The entire pack shall be sealed into a

galvanized frame with metal contour stabilizers, and galvanized steel diagonal support braces on air entering and air leaving side (cardboard is not permitted). Each filter shall have a minimum efficiency reporting value (MERV) of 13% by ASHRAE test standard 52-99.

- C. Filter shall be listed by Underwriters Laboratories as Class 2.

2.11 CABINET HEATERS - ELECTRIC

- A. Provide electric cabinet heaters where shown on Drawings and on schedules. Cabinet heaters shall be factory assembled for field installation. Cabinets shall be 16 gauge steel with corrosion-resistant finish. Color selection shall be by Architect.
- B. Heating coils shall be single terminal end long life electric fin tube with brazed helical coiled fins.
- C. Provide cabinet heaters with automatic reset thermal overload protector.
- D. Provide integral thermostats.
- E. Filters shall be disposable.
- F. Cabinet heaters shall be by Raywall, Q Mark, Brasch or Trane.

2.12 UNIT HEATERS - ELECTRIC

- A. Provide electric unit heaters of horizontal discharge type, by Q Mark, Raywall, Markel, Brasch or Trane, as shown on Drawings and on schedules.
- B. Casings shall be heavy gauge steel with mounting bracket.
- C. Horizontal heaters shall have adjustable steel discharge louvers.
- D. Electric motor shall have integral overload protection and shall be equipped with combination fan guard/motor support resiliently mounted to absorb motor vibration.
- E. Fan blades shall be aluminum directly connected to fan motor and shall be dynamically balanced.
- F. Fan switching shall be available to operate fan independently for summer circulation.
- G. Automatic reset thermal overheat protection shall be wired for instantaneous pilot operation of built-in control contactor holding coil.

2.13 VIBRATION ISOLATION (NON-SEISMIC AND SEISMIC)

- A. Provide Vibration Isolation and Seismic Restraints as specified under Section 23 05 48.

2.14 ACCESS PANELS – (WALL AND CEILING MOUNTED)

- A. Furnish access panels as specified in Sections 23 05 00 and 083113 for access to mechanical equipment as required. Access panels shall be installed under other sections.

2.15 REMOTELY ADJUSTING BALANCING DAMPER

- A. Provide remote balancing dampers meeting the following specifications where shown on plans and described in the specification.
- B. The plans show the location of the remote plate for the remote damper controls and the corresponding terminal unit. Provide the remote plate in the location shown on the plan of the minimum quantity to meet the number dampers that require control. If multiple units are required in one location mount them side by side.
- C. Dampers shall consist of: a 18 ga. (1.3mm) galvanized steel frame with 3 1/2 in. (89mm) depth; blades fabricated from 20 ga. (1mm) galvanized steel; integral 1/2 in. (13mm) dia. axles.
- D. Damper shall be supplied with 9 volt actuator kit (field installed).
- E. All wire connections to be made using RJ11 plugs and sockets, no additional wiring or tools are needed.
- F. Provide plenum rated cables of length required to connect the components.
- G. Provide "Quick Control" remote control device with battery and 5' cable.
- H. Dampers shall be suitable for pressures up to 1 in. wg (.25 kPa), velocities up to 2000 fpm (10.2 m/s) and temperatures up to 180°F (82°C). Testing and ratings to be in accordance with AMCA Standard 500-D.
- I. Provide rectangular, stainless steel wall plates with ports for the number of dampers.
- J. Acceptable manufacturers: Greenheck's RBD-10, Metropolitan Air Technology Electro-Balance, United Enertech or approved equal.

2.16 DUCT COIL - ELECTRIC HEATING

- A. Provide duct electric heating coils, where shown on Drawings, of capacity and type indicated in schedule. Heaters shall be Indeeco, Warren, Brasch, Redd-I or Dell. Coils shall be UL-listed and shall meet requirements of National Electrical Code.
- B. Electric heaters open coils shall be Grade A resistance wire (80% nickel, 20% chromium), insulated with floating ceramic bushings, in aluminized steel frame.
- C. Provide insert heater casing.
- D. Ceramic bushings shall be recessed into openings in aluminized steel brackets and staked in place.
- E. Weld brackets to aluminized steel frame on 3-1/3" centers.
- F. Terminal studs, nuts and washers shall be stainless steel, insulated with phenolic terminal bushings. Terminals shall be machine-crimped to coils.
- G. Heater shall be suitable for zero clearance to combustible surface.
- H. Heater shall be tested dielectrically at 2000 volts before shipment.
- I. Provide differential pressure airflow switch with remote mounting sensor to de-energize heater on lack of air flow. Install sensor upstream of volume box.

- J. Provide built-in automatic reset thermal cutout to break heater load directly upon over-temperature.
- K. Provide built-in manual reset thermal cutout.
- L. Thermal safety cutout's sensing elements shall project fully into the moving air stream. The cutouts shall not be subject to nuisance local overheating due to inadequate air flow. Provide recessed cabinets or other means recommended by the manufacturer, to ensure that nuisance trip outs do not occur.
- M. Provide dry control circuit transformer in heater terminal box, suitable for industrial applications.
- N. Insulate terminal box 1" semi-rigid fibrous glass boards sandwiched between two pieces of sheet metal at base of terminal box.
- O. Provide remote control panels as indicated on Drawings.

2.17 VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS (VRF)

A. General

- 1. This section includes the design, performance, refrigerant details, controls and installation requirements for Daikin VRV systems (Variable Refrigerant Volume) distributed by DXS New England (978-977-9911).
- 2. All units shall be listed and rated by ANSI/AHRI Standard 1230-2010 and meet all minimum IEER performance requirements as scheduled.
- 3. The units shall be ANSI/UL STD 1995 listed and listed by Electrical Testing Labs (ETL) and bear the cETL label.
- 4. All wiring shall be in accordance with the National Electric Code (NEC).
- 5. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
- 6. The system and the design shall be in compliance with ASHRAE 15 Mechanical Refrigerant Code.
- 7. Acceptable manufacturer : Daikin, distributed by DXS New England.
- 8. Submittals for Daikin products not provided by DXS New England will not be considered.
- 9. Alternate manufacturers shall send approval requests to consultant 14 days prior to bid day, and include all information relevant to the alternate VRF system, including but not limited to: unit selections, refrigerant piping layout, refrigerant charge with ASHRAE 15 analysis, branch selector box layout and locations, heating and cooling capacities at design temperatures and including capacity losses from piping lengths, defrost cycles, and combination ratios, dimensional and weight differences, and any other aspect of the system that differs from the system specified.

B. System Description

1. VRF system shall automatically vary the target evaporating and condensing temperatures based on building load and weather conditions to increase part load efficiency (Variable Refrigerant Temperature). The condensing unit shall also feature customizable operating modes which allows for the manual setting of target evaporating and condensing temperatures.
2. Heat Recovery
 - a. System shall permit simultaneous heating and cooling of each indoor unit. Multiple indoor units connected to a single branch selector port shall operate in the same mode (heating or cooling), similar to a two pipe heat pump system. Refer to the controls section of this specification for any central controller and/or mode switchover sequence that may be required.

C. Start-Up And Warranty

1. Installing contractor must be certified by VRF manufacturer. The bidders shall be required to submit training certification proof with bid documents and submittal documents. Untrained contractors who wish to bid this project may contact DXS New England (978-977-9911) to arrange training prior to bid day.
2. The manufacturer shall provide a factory trained service technician to start-up each unit. Manufacturer shall provide instruction to the owners' personnel on proper unit operation and maintenance.
3. The warranty period on all parts and compressors shall commence on the date of initial start-up and shall continue for a period of Ten (10) years not to exceed one hundred and twenty six (126) months from date of shipment. Proper maintenance of the equipment shall be conducted by certified technicians as per the manufacturer or manufacturer's representative requirements. Maintenance logs shall be supplied by the owner upon request.
4. All manufacturer warranty shall be for parts only. All diagnosis and labour warranty shall be carried out by installing contractor as per the warranty requirements of this project.

D. Refrigerant Piping

1. Refer and comply to the refrigerant piping specifications, including the special considerations for VRF refrigerant piping section.
2. Standard T style joints are **not acceptable** for a variable refrigerant volume system. Manufacturer specific Y joints shall be supplied by the VRF manufacturer.

E. Fan Coils

1. Fan coils shall monitor and maintain the unit superheat (cooling mode) or subcooling (heating mode) using a computerized PID control. Internal unit components shall be factory wired and piped, and complete with electronic proportional expansion valve, flare connections, condensate drain pan, self-diagnostics, and auto-restart function.

F. FXSQ – 10" Concealed Ceiling Ducted Unit

1. Daikin indoor unit FXSQ shall be a built-in ceiling concealed fan coil unit with variable speed direct drive DC type fan and auto CFM adjustment at commissioning. Casing shall be constructed of galvanized steel. Configuration shall be horizontal discharge air with horizontal return air, with a maximum height of 9-5/8" and be designed to fit in tight ceiling plenums.
2. The indoor unit's sound pressure shall range from 28 dB(A) to 36 dB(A) at low speed measured 5 feet below the ducted unit.
3. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump shall provide up to 25" of lift from the center of the drain outlet and have a built-in safety shutoff and alarm.
4. The fan shall have a variable speed direct drive DC motor with statically and dynamically balanced impeller with 3 user-selectable fan speeds. The automatic fan speed mode shall allow the fan to vary between 5 speeds based on space load. The unit shall have logic for automatically adjusting external static pressure settings of the fan motor (selectable during commissioning).
5. The unit shall ship from the factory in a rear return configuration and shall be field convertible to a bottom return configuration.
6. Field installed MERV8 filters and filter kits with 2" or 4" filter depths.

G. FXZQ-TAVJU – 4 Way Vista Flat Ceiling Cassette Unit

1. Daikin indoor unit model FXZQ shall be a ceiling cassette fan coil unit with a variable speed direct drive DC type fan for installation into the ceiling cavity, equipped with an air panel grill. It shall be a four-way air distribution type with fresh white or Daikin silver, impact resistant washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°.
2. The indoor unit's sound pressure shall range from 25.5 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.
3. The 4-way supply air flow shall be capable of field modification to 2-way or 3-way airflow to accommodate various installation configurations including corner installations.
4. The decoration panel shall be a low-profile design, extending only 5/16" below the ceiling without any overlap with neighboring ceiling tiles, allowing for installation directly adjacent to other ceiling components such as lights, diffusers, and sprinklers, etc.
5. Return air shall be through the concentric panel, which includes a resin net mold resistant filter. The indoor units shall be equipped with a condensate pan and a factory-mounted condensate pump with up to 21" of lift, and have a built-in safety shutoff and alarm.
6. Three auto-swing positions shall be available to choose from, which include standard, draft prevention and ceiling stain prevention.
7. The fan shall have a variable speed direct drive DC motor with a statically and dynamically balanced impeller with 3 user-selectable fan speeds. The automatic fan speed mode shall allow the fan to vary between 5 speeds based on space load.

8. **Optional:** Units shall be supplied with an optional fresh air intake kit introducing fresh air before the fan by way of direct duct installation to the side of the indoor unit cabinet, and shall allow up to 3% of the unit's nominal airflow.

H. Condensing Unit

1. The condensing unit shall be factory assembled in North America and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of Daikin inverter scroll compressors, motors, fans, heat exchanger, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver (heat recovery only) and suction accumulator.
2. The system will automatically restart operation after a power failure and will not cause any settings to be lost.
3. The unit shall incorporate an auto-charging feature to ensure proper refrigerant charge.
4. The following safety devices shall be included on the condensing unit: high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter, and anti-recycling timers.
5. The Daikin inverter scroll compressors shall be high efficiency reluctance DC (digitally commutating), hermetically sealed, variable speed type. Temperatures and pressures shall be read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value. Non inverter-driven compressors shall not be accepted.
6. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. Upon complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
7. The compressors' motors shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
8. Inverter board shall be refrigerant-cooled to prevent inefficient and unstable operation that can result from air-cooled inverter boards due to varying ambient conditions.
9. The compressor shall be internally isolated to avoid the transmission of vibration.
10. In the case of multiple condenser modules, operation hours of the compressors shall be balanced by means of the Duty Cycling Function.
11. Air Cooled
 - a. The fan motor shall have inherent protection and permanently lubricated bearings. The motor shall be provided with a fan guard to prevent contact with moving parts. The condensing unit shall consist of one or more propeller type, direct-drive 350 or 750 W fan motors that have

multiple speed operation via a DC (digitally commutating) inverter. Motors shall be capable of delivering design air at high external static pressures up to 0.32 in WG (factory set as standard at 0.12 in. WG) to accommodate field applied condensing unit discharge ductwork..

- b. Night setback control for low noise operation shall automatically limit the maximum speed of the fan motor.
- c. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tubes with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
- d. The fins are to be covered with an anti-corrosion hydrophilic blue coating as standard with a salt spray test rating of 1000hr (ASTM B117 & Blister Rating:10), Acetic acid salt spray test of 500hr (ASTM G85 & Blister Rating:10).

12. REL! – Heat Recovery VRV IV Aurora (Cold Climate)

- a. The outdoor unit shall be capable of heating operation down to -22°F ambient temperature. Tested factory data on heating capacity and efficiency shall be available. Continuous heating shall be provided during defrost mode for all multi-module systems.
- b. The outdoor unit shall be capable of cooling operation down to +23°F without any additional low ambient controls.

13. Branch Selector Box

- a. Branch selector box height shall be 9 1/2".

Model	Voltage	MCA	Operating Sound	Max Sound	WxHxD	Weight
		A	dB(A)	dB(A)	inch	lbs
BSF4Q54TVJ	230V 1ph	0.4	37	47	13.75x9.5x23.75	49
BSF6Q54TVJ	230V 1ph	0.6	40.5	50	23.4x9.5x23.75	73
BSF8Q54TVJ	230V 1ph	0.8	40.5	50	23.4x9.5x23.75	81

I. Local Controls

- 1. Fan coil units shall be supplied with individual zone controllers, similar to Daikin model BRC1E73
- 2. Zone controllers shall be hard wired by installing contractor.
- 3. Controllers shall be able to function as follows:
 - a. The controller shall have single and dual setpoints for occupied periods, and independent setback setpoints for unoccupied periods.
 - b. The controller shall have the ability to digitally prohibit individual buttons and functions, including custom mode selection.
 - c. The controller shall have a self diagnosis function that constantly monitors the system for malfunctions.
 - d. The controller shall be equipped with a thermostat sensor.

- e. Controller shall have built-in 7 day, weekday plus Saturday Sunday (5+1+1), weekday plus weekend (5+2) and everyday (1) scheduler.

J. Central Controls

1. Provide an advanced multi-zone controller for installation in a common area as shown on the plans, equal to Daikin iTouch Manager. The controller shall have a 10" LCD touch screen display with the following screen views and functionalities :
2. Central control of set points, schedules, fan speeds, heat/cool mode, and of setback (override) temperature settings during unoccupied periods.
3. Adjustable temperature limits to restrict local wall mounted thermostat setpoint ranges.
4. Visible and audible alarm indication of any system malfunctions with error code.
5. Tiered hierarchy allowing for control of fan coil units independently or as a group.
6. Remotely disable individual functions of the wall mounted zone controllers.
7. Web enabled for remote access from PC, tablet or portable device and automatic alert and error emails.
8. The following two automatic changeover methods shall be available. One shall be selected upon commissioning.
 - a. Averaging Method – the central controller shall sum up the difference between room temperatures and set points for all indoor units in the system. Once this delta reaches the primary changeover deadband of $\pm 2^{\circ}\text{F}$ (adjustable), the central controller shall change over the system automatically.
 - b. Voting Method – The central controller shall evaluate the difference between individual room temperatures and set points, and only include a fan coil in the algorithm if the difference has passed the primary dead band for more than the guard timer, or past the secondary dead band. Heating priority option shall be available.
9. For both automatic changeover options, a weight (0-3) can be added to each indoor unit. The automatic changeover algorithm shall use this weighting to prioritize changeover for the more heavily weighted fan coils.
10. Upon any changeover, a guard timer shall prevent another changeover for a period of 15, 30, or 60 (default) minutes.
11. The guard timer shall be ignored by a change of setpoint manually from either the central controller or the remote controller, by schedule, or if the secondary deadband is reached with either of the automatic changeover algorithms. The secondary changeover deadband shall be the sum of the primary changeover deadband (adjustable) $\pm 1^{\circ}\text{F}$ (adjustable)
 - a. "3D" Floor plan graphic layout
 - b. The central controller shall have the capability for site floor plans to be uploaded as a background to create a graphics interface. Background shall be project specific floor plans rendered in "2D" or "3D".

- c. Floor plan layout shall be displayed both on the local central controller, as well as accessible from the web.
- d. Floor plan will include capability to control indoor unit, and auxiliary inputs / outputs, such as designated lighting control, as follows:
- e. Up to 4 status points to be assigned to the control point icon (room name, room temperature, set point, and mode).
- f. Status and control points to display on corresponding location of zone served on floor plan.
- g. Digital input and output icons will display On/Off status.
- h. Analog input icons will display analog value.
- i. Up to 60 floor layout sections shall be possible depending on project scope.

12. **Optional: BACnet Server**

- a. The iTM BACnet Server Gateway Option shall be capable of making the iTouch Manager work as a BACnet gateway using the BACnet/IP protocol. The iTM BACnet Server Gateway Option shall be capable of exposing indoor unit management points as BACnet objects to the BMS.
- b. The iTM BACnet Server Gateway Option shall allow the following functions:
 - 1) Support Change of Value (COV) notifications.
 - 2) Provide unique virtual BACnet device identification number (ID) for every indoor unit group address.
 - 3) The iTM BACnet Server Gateway Option shall be capable of being configured as a foreign device. It shall be capable of communicating across BACnet Broadcast Management Devices (BBMD) in different subnet networks.
- c. In addition to the standard BACnet VRF points, the Building Management System shall monitor and/or control the following BACnet objects for indoor units:
 - 1) Occupancy Mode : Unoccupied, Occupied, Standby
 - 2) Cooling and heating setpoints during occupied and unoccupied modes.
- d. The Building Management System may choose to monitor and control the following BACnet objects linked to iTM control logic:
 - 1) Enable/Disable iTM Schedule operation.
 - 2) Enable/Disable iTM Auto Changeover Operation.
 - 3) Set Timed Override Minutes - Monitor and configure timer extension for the indoor unit on iTM (30, 60, 90, 120, 150, 180 minutes)
 - 4) System forced off - Enable/Disable all emergency stop programs that are registered on the iTM.
- e. The BMS shall have the ability to utilize scheduling functions on the iTouch Manager.
- f. The BMS shall have the ability to utilize automatic changeover function on the iTouch Manager, removing the need to program automatic changeover sequences on the BMS.

- g. VRF manufacturer shall commission the BACnet server. BMS contractor shall provide VRF manufacturer with static IP address and instance number for commissioning. IP connection shall be by BMS contractor.
- h. All programming for monitoring and control of VRF system via the BACnet server shall be by BMS contractor, as per the Sequence of Operation.

K. Electrical

- 1. Independent electrical power for fan coils and branch selector boxes shall be 208/230 volts, 1 phase, 60 hertz. The unit shall be capable of operating within the limits of 187 volts to 253 volts.
- 2. Unless limited by local electrical codes and standards, multiple fan coils and branch selector boxes can be connected to the same breaker. Field provided individual disconnect switches for each fan coil are required.
- 3. Electrical power for condensing units shall be 208/230 volts, 3 phase, 60 hertz. The unit shall be capable of operating within the limits of 187 volts to 253 volts.
- 4. The control voltage between the indoor and outdoor unit shall be 16VDC. The control wiring shall be communication type stranded non-shielded 18-2 AWG.
- 5. Control wiring shall be installed in a daisy chain configuration between all VRF components as per Manufacturer.

L. Delivery, Storage And Handling

- 1. Units shall be stored and handled according to the manufacturer's recommendations. Units shall be kept clean and isolated from dust and debris.
- 2. Contractor shall inspect all equipment upon delivery and notify shipping company and manufacturer immediately of any damage.

M. Installation

- 1. Install condensing units on a flat surface level within 1/8 inch, and elevated a minimum of 18" from ground or roof surface. Provide intermediate supports as recommended by the equipment manufacturer.
- 2. Provide all necessary control wiring as recommended by the manufacturer.
- 3. High/low pressure gas line, liquid, and suction lines must be individually insulated between the outdoor and indoor units.
- 4. Contact DXS (978-977-9911) prior to installation to review and confirm piping layout and lengths.
- 5. Use refrigeration best practice to allow pipes to expand and contract freely. Review manufacturer installation instructions to ensure expansion joints are properly designed.
- 6. Pressure test ALL systems to 550 PSI after system was vacuumed and held to below 500 microns for at least one hour. Review manufacturer installation instructions for proper pressure test procedures.

2.18 ENERGY RECOVERY VENTILATOR (ERV-1)

A. Manufacturers

1. Subject to compliance with project plans and specifications the following manufacturers are approved to supply products.
 - a. Acceptable Manufacturers
 - b. Oxygen8
2. DOAS Units
 - a. DOAS units shall be factory assembled and tested. Units shall include insulated steel cabinet, total enthalpy plate heat exchanger, fan and motor assembly, filter rack, and integral controls.

B. Cabinet

1. Cabinet shall be nominal 1-inch double wall panel with R6.5 thermal insulation. Cabinet exterior shall be 22-gauge pre-painted steel that meets or exceeds 650-hour salt spray test based on ASTM B117. Liners and other steel components shall be galvanized steel. All seams shall be sealed to provide airtight casing.
2. Doors shall be nominal 1-inch double wall panel with the same construction as cabinet. Doors shall be fitted with hinges and door handles. The doors shall have one lockable handle as standard.
3. The unit will be designed for service and maintenance on the bottom side only to allow for a compact installation.
4. All dampers shall have extruded heavy gauge 6063 aluminum frame that includes jamb seals. Blades shall be airfoil shaped extruded aluminum and include rubber blade seals. Linkage shall be installed in the frame outside of the airstream.
5. All dampers shall include factory mounted, wired and tested actuators. Dampers shall be modulating, or two-position as required. Provide spring return dampers for outdoor air connections.

C. Filters

1. Unit shall include 2-inch filter rack for the outdoor air and return air paths upstream of energy recovery exchanger. Filters shall be accessed through hinged filter access door. Supply one set of MERV 13 pleated filters for the outdoor air stream and one set of MERV8 for the return air stream. All filters must be UL approved.
2. Provide factory mounted pressure sensors to measure filter pressure drop across filters. Pressure drop shall be digital feedback to controller for utilization in control and alarm sequencing. Unit controller shall monitor filter pressure level and report when filter changes are required.

D. Fans

1. Fans shall be mixed flow plenum type with direct drive motor. Fan and motor assembly shall be factory mounted and balanced. The fans will be capable of operating in ambient temperatures of up to 104°F.
2. Fan motors shall be permanent magnet, synchronous motor type with integral digital motor controller. Fan bearings shall be serviceable type with an L-10 life of 40,000 hours. Fan motors will be UL approved.
3. All fans shall be equipped with integral airflow monitoring system connected to the unit controller.
4. Provide means to easily remove fan-motor assembly for service through standard doors.
5. Fans should be designed such that all service can be performed in the field, including replacement of bearings.
6. Fan motor drives shall be 208-230/60/1 and be UL approved. Fans will be protected by UL approved motor protection circuit breaker.

E. Energy Recovery Device

1. Where indicated, units shall include plate type counter flow heat exchanger fabricated with a polymer membrane and aluminum casing. Maximum pressure differential shall be 7.2" w.c. Maximum leakage between airstreams shall be 0.5% of nominal airflow.
2. The energy recovery efficiency must be a minimum of 50% total to meet ASHRAE 90.1.
3. Energy recovery device shall be AHRI 1060 certified.

F. Controls

1. Unit shall include an integrated microprocessor-based unit controller. The controls shall be located in the integral control's cabinet. All unit controls shall operate off a transformer from the main power supply for single point power connection. All internal controls and sensors shall be factory prewired and tested.
2. Include with each unit touch pad type human interface that allows monitoring and control of all unit functions. Human interface shall communicate with unit controller by hardwire connection. Human interface shall be unit mounted.
3. The control system will regulate temperatures, airflows and other functions as required. Unit controller shall be pre-programmed with factory tested software for all possible functions.
4. The controller shall provide the following, refer to sequence of operation for specific unit control sequences;
 - a. Control of fans correcting for both changes in total static pressure and air density in both VAV and constant airflow applications.
 - b. Fan performance monitoring.
 - c. Ventilation airflow monitoring and control.
 - d. Airflow density correction for winter and summer conditions.
 - e. Energy recovery optimization including operation of bypass damper.

- f. Supplemental heating and cooling when included.
 - g. Frost protection.
 - h. Monitoring alarms, faults and maintenance points including filter changeout.
 - i. Time and date schedules.
 - j. Humidity control.
 - k. Data logging and trending.
- 5. Include wireless capability that will allow the client to access remotely via internal wi-fi network.
- 6. If non factory controls are proposed as an option, a factory witness test is required to show integration and functionality.
- 7. Controller shall be BACnet IP and BTL certified and include Modbus communication. Communication shall include monitoring, control, alarms, faults and maintenance information.
- 8. Provide factory installed and tested contactors, overloads, fusing, starters motor speed controllers for supply and exhaust. Include all necessary control transformers.
- 9. Provide unit mounted non-fused disconnect switch with single point power connection.
- 10. Supply all necessary temperature and pressure sensors complete with plug in wiring harnesses for proper option of unit.
- 11. When VRV integration is used, the AHU integration controller (EKEQ) must be factory mounted and wired to EKEXV expansion valve kit.
- 12. Liquid and Gas thermistors are to be mounted to coil and wired to EKEQ kit in the factory.
- G. Plastic Components
 - 1. All plastic components that are in the airstream, must be of a UL94 rated material.
 - 2. If gasketing is used to join unit sections together, gasketing must be a UL94 approved compound.
- H. Installation
 - 1. Install equipment in accordance with manufacturer instructions, these specifications, best practices, and all applicable building codes.
- I. Start Up Service
 - 1. Engage factory authorized service technician to start up and commission units. Provide start up report to owner.

PART 3 - EXECUTION

3.1 SPECIAL RESPONSIBILITIES

- A. Cooperate and coordinate with work of other Sections in executing work of this Section.

B. Gypsum Drywall Enclosures:

1. Coordinate and supervise construction of drywall and related work affecting work of this Section.
2. Work shall include, but not be limited to, the following:
 - a. Supply and return air duct enclosures on air handling equipment.
 - b. Supply air plenums located above rooms.
3. Ensure tightness of plenums and chases used as part of air distribution system. System will not be accepted until proved tight, without leakage. Notify Architect in writing after system test for leakage, if construction and finish of plenums and ducts are not satisfactory.

3.2 TAGS AND VALVE TAG CHARTS

- A. Provide valve tags as required under Section 23 05 00.
- B. Provide valve tag charts as required under section 23 05 00.

3.3 PIPE AND DUCT IDENTIFICATION

- A. Pipe and duct identification shall be provided as specified in section 23 05 00.

3.4 EQUIPMENT TESTING

- A. No tests shall be started until systems have been cleaned. Provide temporary piping and connections for testing, flushing or draining systems to be tested. If leaks develop, repairs shall be made and tests repeated. Tests shall be continued until systems operate without adjustments and repair to equipment or piping. Tests are further specified under other paragraphs of this Section. Test requirement specifically includes, but is not limited to, the following:
 1. Air handling units

Equipment and Piping Testing Checklist

Test Item	Date Confirmed	Manufacturer's Representative Name and Signature	General Representative Name and Signature	Contractor's Representative Name and Signature
Vibration and Alignment				
Refrigeration System Leak Tests				

3.5 DUCT LEAKAGE TESTS (PRESSURE TESTS)

- A. Pressure test ducts after takeoffs and wall penetrations are in place and before applying exterior insulation. Correct any leaks.
- B. For supply systems, perform positive pressure test. For return and exhaust systems on suction side, perform negative pressure test. Duct shall be constructed so there is no joint or structural failure at the test pressure.

- C. Leak testing shall be per SMACNA HVAC Air Duct Leakage Test Manual. Provide orifice assembly including straightening vanes, orifice-plate mounted in straight tube with properly located pressure taps, and U-tube manometer or other device as specified by SMACNA. Orifice assembly shall be calibrated accurately and shall come with calibration curve. Leakage classes shall be as previously specified.
- D. Submittal
 - 1. Submit leak test report (per SMACNA format) for review approval.
 - 2. Drawings of ductwork tested shall also be submitted with report, indicating presence of takeoffs, wall penetrations, joints, etc.

3.6 OEM CONTROLS INTEGRATION

- A. The contractor shall ensure that original equipment manufacturers (OEM), providing equipment with integral controllers (DDC, electric, electronic or pneumatic), shall coordinate with the Building Controls System (BCS) contractor to ensure complete integration of the OEM controls with the BCS. Provision of any gateways, wiring, etc., shall be by the BCS contractor.
- B. The mechanical contractor shall refer to the Building Controls Systems drawings to ensure the sequences required by OEM equipment are followed.
- C. The OEM controllers shall coordinate with the BCS contractor to provide for the following, as applicable to the device, for connection by the BCS contractor.
 - 1. Remote start/stop.
 - 2. Remote set-point adjust.
 - 3. Remote alarming.
 - 4. Remote status.
 - 5. Remote monitoring of all process variables measured by the OEM controller. In short, all information that is available on the local OEM control panel shall be communicated to the BCS.

3.7 EQUIPMENT START UP

- A. Start up the following pieces of equipment in strict accordance with manufacturer's instructions and with manufacturer's representative present:
 - 1. ERV-1
 - 2. VRF/ACCU-1

- B. Complete the following checklist to certify to the Architect that start up of the above pieces of equipment has successfully been accomplished. Copy multiple checklists as required. Edit inappropriate items as required.

EQUIPMENT START UP CHECKLIST			
Equipment List	Date Confirmed	Manufacturer's Representative Name and Signature	General Contractor's Representative Name and Signature
ERV-1			
VRF/ACCU-1			

3.8 HVAC SYSTEMS DEMOLITION

- A. Shut-off, disconnect, make inactive and dismantle existing HVAC systems to be demolished and leave HVAC equipment, duct work, piping and debris on floor for removal under Section 024119 - Selective Demolition. Disconnect existing HVAC equipment to be demolished and identify items to be removed with orange spray paint for removal and disposal under Section 024119 - Selective Demolition.
- B. Remove ductwork and piping back to active main and provide dampers, valves, cap or plug to suit system. Obtain existing record drawings from Owner. Maintain existing HVAC risers and ductwork serving outlets to remain.
- C. After walls and ceilings are removed and duct work and piping are exposed, verify duct work and piping serves only HVAC systems in areas indicated for demolition before shut-down for disconnection. Identify existing ductwork and piping that serves systems to remain. Promptly notify Architect of active ductwork and piping to be maintained when located in partitions to be demolished.
- D. Dispose of environmentally sensitive materials (refrigerants, glycol, etc.) as required by the authority having jurisdiction.

END OF SECTION

SECTION 230900 - BUILDING CONTROLS SYSTEM (BCS)
TABLE OF CONTENTS

PART 1 - GENERAL	1
1.1 DESCRIPTION OF WORK	1
1.2 COORDINATED WORK	2
1.3 QUALITY ASSURANCE	2
1.4 SUBMITTALS	3
1.5 DELIVERY, STORAGE AND HANDLING	4
1.6 AGENCY APPROVALS	4
1.7 OPERATING AND MAINTENANCE MANUALS	4
1.8 WARRANTY	5
1.9 AS-BUILTS	5
1.10 INSPECTION	5
1.11 INSTALLATION OF BUILDING CONTROL SYSTEMS	5
1.12 TEST AND START-UP & ADJUSTING AND CLEANING	6
1.13 INSTRUMENTATION	6
1.14 CLOSEOUT PROCEDURES	12
1.15 TRAINING	12
1.16 SYSTEM STARTUP	13
1.17 TESTING	13
1.18 ACCEPTABLE MANUFACTURERS	13
1.19 OPERATING ENVIRONMENT	13
1.20 DESCRIPTION OF WORK	13
1.21 DEFINITIONS	14
1.22 SOFTWARE	14
1.23 HARDWARE REQUIREMENTS	15
1.24 SOFTWARE OWNERSHIP	15
1.25 UPGRADES	15
1.26 FIELD DEVICES	15
1.27 PNEUMATIC SIGNALING	15
1.28 CONTRACTOR RESPONSIBILITIES	15
1.29 COMPLIANCE	15
PART 2 - PRODUCTS	16
2.1 BCS – DDC/EMS SYSTEM	16
2.2 BCS – DDC/EMS HARDWARE	18
2.3 BCS SOFTWARE	30
2.4 FIELD DEVICES	41
2.5 WIRING AND CABLING	49
2.6 SEQUENCES OF OPERATION	50
PART 3 - EXECUTION	50
3.1 OEM CONTROLLER INTEGRATION	50
3.2 PROCEDURES	51
3.3 EQUIPMENT STARTUP	52
3.4 BUILDING CONTROLS SYSTEM	52
3.5 SOFTWARE INSTALLATION	56
3.6 DATABASE CONFIGURATION	56
3.7 COLOR GRAPHIC SLIDES	56
3.8 REPORTS	56
3.9 DOCUMENTATION	56
3.10 MOUNTING AND INSTALLATION PRACTICES	56
3.11 ENCLOSURES	57
3.12 LOCATION	58
3.13 IDENTIFICATION	58
3.14 CLEANUP	59
3.15 POWER WIRING	59
3.16 MEDIA CONVERSION	59

SECTION 230900
BUILDING CONTROLS SYSTEM (BCS)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The Contractor shall furnish and install a complete building automation system including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification and as shown on the drawings. All components of the system – workstations, application controllers, unitary controllers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2001. No gateways shall be used for communication to controllers furnished under this section. At a minimum, provide controls for the following:
1. Energy Recovery Ventilator
 2. Air Volume Control Devices
 3. Monitoring, alarming and reset control of original equipment manufacturers package controllers such as boilers, etc.
 4. Power wiring for control equipment including panels, dampers, filters, actuators and other control equipment specified under ATC shall be by this Section. Wire to closest emergency (when available) normal electrical branch circuit panel for final connection to 20A-1P circuit breaker by Section 26 10 00.
 5. Exhaust and supply fans.
- B. Demolition of existing HVAC equipment, ductwork, piping, automatic temperature controls and appurtenances.
- C. The work included under this section of the specifications and drawings includes the complete installation of a building controls system utilizing (digital controllers) (pneumatic controllers) (electric controllers).
- D. The Contractor shall furnish and install a complete building control system including all necessary hardware (and all operating and applications software) necessary to perform the control sequences of operation as called for in the documents. All required operation parameters, setpoints, schedules, and (software) shall be submitted to the Owner ready for use.
- E. The Drawings and Specifications are not intended to show all details. The Contractor shall secure satisfactory information before submitting the proposal and include in the proposal a sum sufficient to cover all items of labor and material required for the complete installation of the devices and system described.
- F. All work performed under this section of the specifications shall comply with all codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the more stringent requirement shall apply.
- G. The Contractor, as part of the bid proposal, shall indicate the manufacturer of the controllers being proposed for this project and the model numbers. This information shall be indicated on the Bid Form.
- H. The Contractor shall obtain and pay for all necessary construction permits and licenses.

- I. The Contractor shall furnish all control valves and control dampers (except valves and dampers inside air handling units where only actuators may be required if not provided by equipment manufacturer) indicated on control drawings. Installation shall be by Section 23 06 00, supervised by this section contractor.
- J. The Contractor shall furnish and install all actuators including necessary linkages, wiring, conduit and/or pneumatic tubing.
- K. The Contractor shall provide all necessary field control and interlock wiring including auxiliary contacts, push buttons, switches and indicating lamps necessary. Division 26 shall provide circuit breakers in electric panels. This contractor shall provide wiring and conduit from the circuit breakers to the control panels. Power provided by Division 26 will be 120 Volts. This contractor shall provide transformers to reduce the voltage if required by this contractor's equipment. This Contractor shall coordinate with the Division 26 Contractor for locations of panels.
- L. The Contractor shall provide all sensors, transducers and miscellaneous equipment to provide the specified control sequences. The terminal volume box controllers provided by this Contractor shall be mounted on the individual boxes at the terminal volume box manufacturer's factory.
- M. Provide services and manpower necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor and Owner's representative.

1.2 COORDINATED WORK

- A. The Contractor shall cooperate with others performing work on this project as necessary to achieve a complete and neat installation. Consult the drawings and specifications of all trades to determine the nature and extent of others' work.
- B. It will be the duty of the Contractor to work in cooperation with the Owner's Representative, and with other Contractors and Employees, rendering assistance and arranging his work so that the entire project will be delivered in the best possible condition and in the shortest time.
- C. The Contractor and Manufacturers supplying equipment with packaged controls (boilers, computer room units, chillers, etc.) shall coordinate with each other to develop program code to interface all packaged controllers to the BCS to perform all monitoring, alarming and/or control required by the drawings and specifications. It shall be incumbent upon this Contractor to ensure such coordination occurs.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of the specified style of control systems equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firms specializing and experienced in the specified style of control systems installations for not less than 5 years.
- C. Codes and Standards (Latest Editions):
 - 1. Electrical Standards: Provide electrical products, which have been tested, listed and labeled by (UL) and comply with NEMA standards.
 - 2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
4. NFPA 92A "Smoke Control Systems" where applicable to controls and control systems.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.
- B. Shop Drawings: Submit shop drawings for each control system, containing the following information:
 1. Schematic flow diagram of system showing all components and equipment including narrative description of the sequence.
 2. Label each control device with setting and adjustable range of control.
 3. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
 4. Provide details of faces of control panels, including controls, instruments and labeling.
 5. Database list showing point tag, point description type, (processor address, module address), termination point and (channel number), signal range, power source and remarks.
 6. SAMA type functional logic diagrams showing analog loop and digital logic. These drawings shall show complete configuration details including I/O address, register values, function generator values, block numbers, connection points, ranges and all necessary configuration specifications.
 7. External wiring termination drawings.
 8. Physical arrangement drawings showing outline dimensions and internal arrangement of equipment.
 9. Power distribution and grounding drawings.
 10. System cabling diagram for all system interconnecting cables.
 11. Configuration listing and diskettes.
 12. Control ladder diagrams.
 13. List of process variables, which will be monitored from the OEM controllers.
 14. Bill of components.
 15. Valve and damper schedules showing sizes, capacities, flow coefficient, pressure drop, configuration and location.

- C. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.
- D. All shop drawings shall be prepared on computer aided drafting software or equivalent. Drawing sheet size shall be 11" x 17".
- E. Shop drawings shall include a riser diagram depicting locations of all controllers (and workstations, with associated network wiring). Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller.
- F. Submittal data shall contain manufacturer's data on all products used in the project. In addition, submittals shall contain sequences of operation, (program listings), point lists, and a complete description of the (graphics, reports), alarms and configuration to be furnished (with the workstation software). Information shall be bound.
- G. Prior to ordering or fabricating equipment, submit shop drawings in accordance with Division 01.
- H. Control logic diagrams shall be in ladder logic format.
- I. Shop drawings shall include air piping riser diagram floor plan showing location of compressor, dryer, receiver, and tabulated results of air consumption calculations.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

1.6 AGENCY APPROVALS

- A. All controllers shall be UL approved as an Energy Management System (UL 916).
- B. All controllers used on smoke control systems shall be UL approved for a Smoke Control System (UL 854).
- C. All electrical components shall be UL listed or labeled.
- D. All wiring shall conform to the National Electric Code.
- E. Equipment, piping and wiring installed in conditioned air streams, spaces or plenums shall comply with NFPA 90A flame/smoke/fuel contributing rating of 25/50/0.
- F. Comply with FCC rules Part 15 regarding Class A radiation from computing devices and low power communication equipment operating in commercial environments.
- G. Comply with FCC rules, Part 68 for telephone modems and data sets.

1.7 OPERATING AND MAINTENANCE MANUALS

- A. The Contractor shall provide operating and maintenance manuals consisting of, at a minimum, component data sheets, maintenance and calibration procedures, software print-outs, code documentation and point-to-point wiring diagrams.

1.8 WARRANTY

- A. The Contractor shall provide a warranty against defects in materials or workmanship in the BCS as described in this specification. Term of warranty is as follows (after system start-up has been completed and accepted by the Owner):
- | | | |
|----|-------------------|-----------|
| 1. | Control equipment | 36 Months |
| 2. | Control sensors | 36 Months |
| 3. | All else | 12 Months |
- B. Updates to the manufacturer's software shall be provided at no charge during the warranty period.

1.9 AS-BUILTS

- A. Within 90 days following project completion and testing, the Contractor shall submit as-built drawings reflecting the exact installation of the system. (The as-built documentation shall also include a copy of all application software both in written form and on DVD).

1.10 INSPECTION

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

1.11 INSTALLATION OF BUILDING CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-16 sections of these specifications. Mount controllers at convenient locations and heights.
- B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.
- C. Wiring System: Install complete control wiring system for control systems. Following manufacturer's recommendations for use of shielded cable for field signal wiring, wire and cable separation criteria by type of point and signal level, power supply and grounding. Wire and cable shall be run in EMT conduit except in control rooms where wireway may be used and outdoors where rigid steel conduit shall be used. Final connection to devices shall be made in flexible steel sealed conduit. The length of flexible sealed steel conduit shall not exceed 3 feet. Provide multi-conductor multi-pair instrumentation cable (bundle) in place of single pair cable where number of conductors (pairs) can be run along common path. Do not run conduit over equipment removal areas or under the path of movable cranes or monorails. Coordinate conduit runs with other contractors on coordination drawings before installation. Obtain approval for conduit drawings prior to installation. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors and cable neatly. Single pair instrumentation cable shall be 300 volt insulation No. 16 AWG shielded and twisted with half-lap aluminum mylar wrap with copper drain wire with flame retardant jacket. Multi-pair instrumentation cable shall of the same construction as single pair except that the minimum wire size shall be No. 20 AWG.
- D. Number code conductors and pneumatic tubing with permanent wire markers and labeling system for future identification and servicing of control system.

- E. Reset Limit Controls: Install manual-reset limit controls to be independent of power controllers; automatic duct heater resets may, at Contractor's option, be installed in interlock circuit of power controllers.
- F. Unit Mounted Equipment: Where control devices provided by this Contractor are indicated to be unit-mounted, ship relays, switches, valves, dampers, and damper motors to unit manufacturer for mounting and wiring at factory. Coordinate all shipping with the unit manufacturers.

1.12 TEST AND START-UP & ADJUSTING AND CLEANING

- A. Start-Up: Start-up, test, and adjust control systems in presence of manufacturer's authorized representative and the Owner's Representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Field Testing and Start-up: The Contractor shall provide the services of a qualified service representative to check system installation and supervise the system power up and initial check-out. All travel and living expenses shall be included in the bid.
- C. The Contractor shall include 30 days of on-site start-up engineering service in his bid. All travel and living expenses shall be included in the bid.

1.13 INSTRUMENTATION

- A. Instrumentation shall be in accordance with the following Codes and Standards:
 - 1. Instrument Society of American (ISA) Standards:
 - a. RP7.1 Pneumatic Control Circuit Pressure Test
 - b. S5.1 Instrumentation Symbols and Identification
 - c. S75.03 Uniform Face-to-Face Dimensions for Flanged Globe Style Control Valve Bodies.
 - d. S75.04 Face-to-Face Dimensions of Flangeless Control Valves
 - 2. American Society of Mechanical Engineers (ASME) Publication:
 - a. Fluid Meters, Their Theory and Application
 - 3. American Society for Testing and Materials (ASTM) Standards:
 - a. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 - b. A213 - Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes.
 - c. B88 - Seamless Copper Water Tube
 - d. B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
 - 4. National Electrical Manufacturers Association (NEMA) Standards:
 - a. ICS1 - General Standards for Industrial Control and Systems

- b. 250 - Enclosures for Electrical Equipment (1000 volts maximum).
 - 5. National Fire Protection Association (NFPA) Standards:
 - a. No. 70 - National Electrical Code
 - b. No. 92A – Smoke Control.
 - c. No. 90A – Air Conditioning Systems.
 - 6. Underwriters Laboratories (UL)
 - a. UL50 - Electrical Cabinets and Boxes
 - b. UL916 – Energy Management System.
 - c. UL854 – Smoke Control System.
- B. Instrumentation
 - 1. Requirements for instrumentation to be furnished are contained in other sections of this division
- C. Tubing, Piping and Fittings
 - 1. Primary Impulse Tubing: ASTM A 213, Type 304 stainless steel seamless 1/2 inch O.D., 0.035 inch wall thickness.
 - 2. Primary Impulse Tubing Fittings: Type 316 stainless steel union compression type.
 - 3. Instrument Air and Control Air Piping:
 - a. Main header: 1 1/2 inch ASTM B 88, Type L copper.
 - b. Branches 1 inch and under: ASTM B 88, Type L copper.
 - c. Minimum branch: 1/2 inch (1/4 inch permissible for instrument air downstream of the filter regulator).
 - 4. Control Air Tubing: Where allowed, 1/4 inch od, 0.035 inch wall ASTM B280, C12200 copper refrigeration tubing.
 - 5. Controls Air Fittings: Brass union compression type throughout.
- D. Instrument Valves
 - 1. Instrument Valves: Type 316 stainless steel with union compression ends. The maximum size orifice diameter for the valve size wall is provided.
 - 2. Instrument Air User Shut Off Valves: Bronze ball valves.
- E. Instrumentation Identification
 - 1. Each major component of equipment shall have a standard manufacturer's nameplate showing the serial number, model number and the manufacturer's name and address. Other information as the manufacturer may consider necessary to

complete identification shall be shown. The nameplate of the distributing agent will not be acceptable.

2. Nameplates: Aluminum, brass or corrosion resistant steel, securely affixed by the means of rivets or sheet metal screws in a conspicuous place.
3. All field mounted instrument and control devices shall be provided with permanently attached aluminum or stainless steel instrument tags. The tags shall be embossed with the instrument tag number and service description (valve size and Cv where applicable). Instruments mounted inside or on the front of control panels shall be identified with laminated plastic nameplates engraved with vertical Gothic characters. Field mounted instrument tag numbers shall be as shown and specified.

F. Installation-General Requirements

1. Install gages and thermometers where indicated on Drawings or called for in specifications.
2. The Contractor shall be responsible for installation, connections (Including mounting accessories) and testing of all instruments.
3. All field mounted instruments shall be mounted in accessible locations, 4 feet 6 inches above the floor or platform, unless instrument design requires mounting on process piping, ductwork or equipment, or unless otherwise shown.
4. All instruments, tubing and accessories shall be firmly secured to building walls, ceilings, or platforms using fasteners designed specifically for the purpose for which they are being used.

G. Installation-Primary Impulse Piping

1. The Contractor shall provide instrument piping and tubing, fittings, valves, calibration manifolds, plugs and bleed valves on the root valves and accessories for each instrument. The Contractor shall locate instrument connections on the piping in accordance with the flow diagrams. Locally mounted pressure gauges and thermometers shall be installed so that the plant operations personnel without the use of ladders can easily read the instrument. Gauge glasses shall be installed so that they are offset from the vessel with clearance from insulation with easy access to be read by the plant operations personnel.
2. Pipe and tubing shall be routed in a manner to prevent stress failure due to vibration, thermal expansion or any other movement to be expected during normal operation. Refer to Division 23 Vibration Isolation for required spring hangers and flexible piping connectors.
3. Piping systems extend from the process connections (root valves) at the pipe or vessel to the respective instruments and devices.
4. Tubing shall not be routed across equipment removal areas, below monorails or cranes nor above or below removable sections of gratings.
5. With the exception of gas measuring and vacuum instruments, all instruments shall be located below the process source connection, unless otherwise shown.
6. Instrument piping and tubing shall be as short as is practical. Equivalent vertical head (vertical distance between pressure source and transmitter) in psig shall be less than 20 percent of the transmitter range, unless otherwise shown.

7. Instrument piping and tubing runs shall be supported and protected to prevent sagging, damage and erroneous measurements.
8. Hanger materials shall be beam clamps, turnbuckle, rod hangers and split clamps for around pipe girth. When possible, instrument tubing and piping shall be routed together. Channel members and tubing clamps shall commonly support by support tray and groups.
9. Horizontal runs of instrument piping and tubing shall be straight without pockets, sloped 1/4 inch per foot minimum and where possible grouped and supported in metal trays (Tube Track or equal) or run along walls or ceilings to obtain maximum physical protection. Vertical and single runs of tubing shall be run in protected areas such as angles, channels, column webs, etc.
10. All threads shall be clean machine cut with all burrs and chips removed. Lubricants shall be of dry film type. Apply pipe thread lubricant so that it does not extend beyond the first engaged pipe thread. The Contractor shall be responsible for correction, repair or replacement of instrumentation, which malfunctions during the warranty period of thread lubricant, is determined to be a contributing factor to the malfunction.
11. The inside and outside of all piping and tubing shall be free of sand, loosely adhering scale, dirt, and other foreign matter. Prior to testing of the systems, purge all sand and adhering scale from the inner surfaces of all instrument piping and tubing. The method of cleaning shall not leave any material on the inner or outer surfaces that will affect the serviceability of the piping, tubing, valves and instruments.
12. Piping and tubing runs shall be field fabricated from random or stock length pipe and lengths of coils or tubing. Sawing or roller type tube cutters shall cut stainless steel tubing. Flame heating will not be permitted on stainless steel materials. Roller type tube cutters shall cut copper tubing. Clean all cut ends inside and outside surfaces prior to joint assembly. Bending radius for any bends in pipe shall not be less than an five times the outside diameter of the pipe. Minimum bending radius for tubing shall be as follows:

Outside Diameter	Minimum Radius
1/4 inch (where allowed)	9/16 inch
1/2 inch	1-1/2 inch
5/8 inch	1-1/2 inch
3/4 inch	1-3/4 inch

13. Bends shall be true to angle and radius and shall maintain a true circular cross-section of piping or tubing without buckling or undue stretching of pipe or tubing wall.
14. All pressure and differential pressure instruments, which are remote mounted, shall be provided with 316 stainless steel calibration manifolds. For pressure devices two-valve manifolds shall be provided, and for differential pressure devices five-valve manifolds shall be provided.

H. Installation-Instrumentation Air and Control Air Piping

1. Provide Instrument Air System - Instrument air system shall originate from the service air system downstream of the air receiver. Provide 1 1/2 inch ASTM B 88 Type L copper instrument air header, 1 1/2 inch coalescent prefilter, 25 cfm at 125 psig air dryer rated for -40 degree F dew point air at the dryer outlet, 1 1/2 inch coalescent after filter, 1 1/2 inch brass body stainless steel ball valves between each piece of equipment and every 100 feet of header downstream of the after filter. Provide a full line size bypass around the air dryer with a shutoff valve. Run the instrument air header around the new plant. The air dryer shall include a discharge pressure gauge and discharge relative humidity indication. Coalescent filters shall include a differential pressure gauge. The Contractor shall pipe drains from the coalescent filters and air dryer to a floor drain.
2. Branch from the instrument air piping header to feed users of instrument air. All branches off of the main header shall have isolation valves provided at the branch tee or coupling.
3. Control air tubing shall be routed and supported as specified for Primary Impulse Piping.
4. Control air tubing located outdoors shall be electrically heat traced and insulated.

I. Subpanels

1. Subpanels (pipe stands) shall be provided for mounting instruments, which are not installed directly on a pipe or vessel.

J. Testing and Inspection

1. A test program established by the Contractor shall include the following:
 - a. Testing procedures.
 - b. Leak tests shall be performed on all pipe and tubing lines or systems installed.
 - c. The test pressure shall be held long enough to inspect the lines being tested, but not less than 30 minutes, with no addition of test fluid and no loss of pressure.
 - d. Leakage of test fluid, deficiencies or other faulty conditions determined during the tests shall be corrected by the Contractor after which the test shall be repeated until satisfactory results are obtained.
 - e. Instruments, controls and other components shall not be subject to test pressure or testing fluids if corrosion, residue or other effects could occur. The Contractor shall disconnect or valve and vent all items, which could be affected.
 - f. Test fluids shall not cause corrosion, residues or other adverse effects to the pipe or tubing components being tested.
 - g. Pipe or tube lines or system used for permanent (air distribution), air or gas impulse, (or pneumatic controls or signals) shall not have liquids introduced into them at any time. All testing shall be done with a dry, oil free gas.

- h. Liquid test fluids containing chlorides, sulfur, halogen and/or lead compounds are prohibited.
 - 2. Test pressures shall be as follows:
 - a. Hydrostatic Tests: 150 percent of the system design pressure. All testing shall be in accordance with ISA RP7.1.
 - b. All copper tubing signal and air supply lines shall be pneumatically tested at 150 psig pressure.
 - c. All tubing connections on the final elements shall be tested with soap bubble solution while subjected to maximum operating pressure. The testing shall be in accordance with ISA RP7.1.
 - 3. The Contractor shall perform valve operational performance checks on all valves and valve manifolds.
 - a. The checks shall be performed after installation of the valve or valve manifold.
 - b. Each valve or valve manifold provided by the Contractor shall be cycled full open, full closed at design pressure, or greater, to insure the proper functioning of the valve.
 - 4. Prior to testing, all instrument piping shall be flushed and tested, (pneumatic pipe and tubing blown down and tested) and electrical wiring checked. All of the work shall be checked against installation drawings. Electrical (and air supplies) from the permanent source shall be available.
 - 5. Test sources and test gages, designated as secondary calibration sources, shall be properly calibrated from a primary calibration source. The primary source shall be calibrated and traceable to the National Institute of Science and Technology (NIST). The secondary source accuracy shall be at least 2 orders of magnitude greater than the device being checked.
- K. Calibration/Setting/Tuning
- 1. All field mounted devices shall be calibrated and set by the Contractor after installation in the system.
 - 2. All test sources shall be applied to the increase as well as the decrease drive direction in order to check loop repeatability.
 - 3. A separate instrument calibration sheet shall be completed for each instrument. When the instrument is calibrated and/or set, the instrument shall be marked with a calibration tag and contains the date of calibration.
 - 4. Test sources and test gages, designated as secondary calibration sources, shall be properly calibrated from a primary calibration source. The primary source shall be calibrated and traceable to the NIST. The secondary source accuracy shall be at least 2 orders of magnitude greater than the device being checked.
 - 5. Any device which does not meet the manufacturer's stated accuracy and/or repeatability, or which reveals any malfunction, shall be replaced by the Contractor at no cost.

6. Analog devices shall be checked at a minimum of three points; 0 percent, 50 percent, and 100 percent of span.
7. Switches shall be set in the specified direction of the primary driving signal. Deadband shall be set as specified.
8. All control valves shall be tuned. This work includes, but is not limited to the following:
 - a. Zero and span adjustments. Positioner range spring adjustments for control valve zero and maximum travel shall be made using a Transmutation or equal calibrator.
9. Written records shall be kept for each calibration showing date, system or equipment calibrated, method and results. Calibration records shall be submitted to the Owners Representative for each calibration within 10 working days after completion of calibration.
10. Performance test shall be conducted following satisfactory completion of operational testing.
11. In the event of instrumentation malfunction, defects shall be corrected and the test procedures repeated a sufficient number of times to satisfy the Owners Representative that the repairs are permanent and correct, and that system reliability has been demonstrated.

L. Instrument Installation

1. Provide pulsation dampers for all pressure gauges located at the discharge of pumps and compressors.
2. Provide siphons for all pressure gauges used for steam service.
3. Provide condensate reservoirs on the upper connections of level instruments for steam service and for both high and low side taps for steam flow instrumentation.

M. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

N. Final Adjustment: After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section.

1.14 CLOSEOUT PROCEDURES

A. Owner's Instructions: Provide services of manufacturer's technical representative for (one 40-hour) sessions to instruct Owner's personnel in operation and maintenance of the Distributed Control Systems. (Contractor shall record the entire instruction period on DVD and submit to the Owner.)

1. Schedule instruction with the Owner's Representative, provide at least 14-day notice to the Owner's Representative of training date.

1.15 TRAINING

A. The Contractor shall include in his proposal (40 hours) of on-site operator training.

B. Training shall include but shall not be limited to the following:

1. Instruction in programming.
 2. Instructions in the language programming.
- C. Provide for the training sessions, text books, workbooks and similar materials for personnel, which shall be retained by those personnel upon completion of training. Provide an extra clean copy of the material to be filed with the O&M manuals.

1.16 SYSTEM STARTUP

- A. After all field connections have been made and control power is available to each control panel, the Owner's Representative shall be notified and the control system shall be enabled by the BCS Contractor. (Any software loading shall be done at this time and) the start-up of the mechanical or electrical system shall commence.

1.17 TESTING

- A. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BCS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.
- B. The BCS Contractor shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner's representatives.
- C. The BCS Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting and balancing all systems in the building. The BCS Contractor shall have a trained technician available on request during the balancing of the systems. The BCS Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in his contract.

1.18 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, the Manufacturer shall have at least 10 years of experience in production of control systems of the type specified for commercial applications and shall be Automated Logic, Honeywell, Johnson Controls, Schneider Electric, Trane or Siemens or approved equal.

1.19 OPERATING ENVIRONMENT

- A. All controllers shall be capable of operating in an environment of 0 to 120 degrees F and 10 - 95% relative humidity (non-condensing).

1.20 DESCRIPTION OF WORK

- A. The building controls system shall consist of peer to peer network controllers and workstations on a high speed backbone (Ethernet), supporting peer to peer distributed controllers on a field bus.
- B. In addition to the specified hardware, software and field devices, the contractor shall furnish all labor to design, program and install the BCS.

- C. The scope of work includes testing, startup training and warranty work specified.
- D. The Building Controls System (BCS) shall be designed in strict accordance with ASHRAE's BACnet standard, 135-2001 to provide interoperability between different building subsystems. The system shall also provide a graphical, web-based operator interface that allows for instant access to any system through a standard browser. The system shall use BACnet network types and protocols exclusively. Non-BACnet based systems are not acceptable. The contractor must provide PC-based programming workstations, operator workstations and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions. Contractor must provide manufacturer's Protocol Implementation Conformance Statement (PICS) for workstation software and every controller model that is installed.

1.21 DEFINITIONS

- A. The term "implement" means to develop and/or utilize a software and/or hardware component to meet the system criteria or system verification as part of the work covered in this section.
- B. The term "multi-vendor integration" when referenced herein shall imply the hardware equipment and software programs needed for communications to the various mechanical and/or electrical systems contained in the scope of work.
- C. BCS: The environmental monitoring and control system including lighting, inclusive of all appurtenances required for the control and monitoring of the mechanical, electrical, or other systems unless specifically exempted within this specification. This definition includes both hardware devices and software components that are integrated to form a working system.
- D. The term "BCS Contractor" is the successful offerer of the building controls system as specified in Section 23 09 00.
- E. HVAC: Heating, Ventilation and Air Conditioning.
- F. Stand-Alone System: Performs all control functions independently without direction from a central unit.
- G. Hardware: The physical components in the BCS system.
- H. Point: A single monitoring or control device connected to the BCS.
- I. Control Wiring: All wiring, 120 VAC line voltage or lower other than power wiring, required for the proper operation of the mechanical system and the BCS. This includes applications where line voltage also serves as a control circuit such as a line voltage thermostat or involves interlocking with a damper.
- J. Power Wiring: All line voltage wiring to the mechanical and BCS equipment that is required for proper operation of the equipment. Typically, this wiring will support voltage at or above 120 VAC and is connected to the equipment for the purpose of providing motive power.
- K. Ethernet: Broadcast networking system that carries digital data packets to local nodes. It is a (10, 100) Mbps base-band LAN.

1.22 SOFTWARE

- A. Controller software refers to the capabilities of the firmware resident in each Level 1 or Level 2 controller. As such it describes the overall operating capabilities, communications, and application level function of the particular controller. All controller level firmware is to be resident in ROM, and must be socketable to allow for future upgrades.

- B. Workstation software encompasses the operating system, database and application software for use on the personal computer workstations. This software may be provided on diskettes, tapes or CD ROMs. It is sold as a software license and is intended to be upgraded over time as new features become available.

1.23 HARDWARE REQUIREMENTS

- A. All operator interface hardware including workstations, laptop computer, and file server shall be IBM compatible.

1.24 SOFTWARE OWNERSHIP

- A. All software, including the energy management system, shall become the property of the Owner. The Owner shall have rights to use and/or alter any part of the system without restriction.
- B. Ownership of the software shall not allow infringement upon the supplier's copyrights.

1.25 UPGRADES

- A. Provide software upgrades during the warranty period as the manufacturer's product is improved at no cost to the Owner. Furnish confirmation letter to the Owner before system acceptance indicating that the latest software versions are installed as of turn-over date and at the end of the warranty period that all upgrades have been provided.

1.26 FIELD DEVICES

- A. Included with field devices are all gauges, sensors, transmitters, transducers, wells, relays, switches and power supplies necessary for the operation of the BCS System.
- B. All field devices shall include the associated tubing, wiring, conduit, mounting, and enclosures.
- C. Also included are sensors, control valves, control dampers, smoke dampers, valve actuators, damper actuators, relays, and conventional controls necessary for a completely functioning system in accordance with the sequences of operation.

1.27 PNEUMATIC SIGNALING

- A. Pneumatic devices shall be restricted to actuation of final controlled devices only. A pneumatic signal shall not be allowed for either sensing or start/stop control.

1.28 CONTRACTOR RESPONSIBILITIES

- A. Installation of the building controls system shall be performed by the Contractor or a subcontractor. However, all installation shall be under the personal supervision of the Contractor. The Contractor shall certify all work as proper and complete and shall reflect actual installation on the project record documentation. Under no circumstances shall the design, scheduling, coordination, wiring terminations, programming, point calibration and check-out, training, and warranty requirements for the project be delegated to a subcontractor.

1.29 COMPLIANCE

- A. All wiring shall be installed in accordance with all applicable electrical codes and Division 26, and shall comply with equipment manufacturer's recommendations.

- B. Should any discrepancy be found between wiring specifications in Article 23 09 00 and Division 26, the more stringent requirement shall prevail.

PART 2 - PRODUCTS

2.1 BCS – DDC/EMS SYSTEM

A. System Overview

1. The Building Controls System (BCS) shall consist of microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions.
2. There shall be two levels of controllers. Level 1 controllers shall contain a high speed LAN communication bus capable of sharing data among personal computer work stations, other Level 1 controllers, and a central file server. Level 1 controllers shall also contain a communication bus to Level 2 controllers, referred to throughout the specification as the field bus. Level 1 controllers are primarily central plant controllers and network integrators. Level 2 controllers are dedicated DDC controllers for standalone operation of HVAC equipment, lighting and plumbing equipment. These controllers shall communicate to either a work station on the high speed LAN via a level 1 controller or a portable laptop computer for the purposes of monitoring and programming.

B. Level 1 Controller Description

1. A minimum of two (2) Level 1 controllers shall provide overall system coordination, accept control programs, perform automated DDC and energy management functions, control peripheral devices and perform all necessary mathematical functions. The controller shall be a microcomputer of modular design. The word size shall be 16 bits or larger, with a memory cycle time of less than 1 microsecond. Level 1 controllers shall share information with and from the entire network of Level 1 and Level 2 controllers for full global control. Level 1 controllers shall permit multi-user operation from work stations and laptop computers connected either locally or over the Level 1 network.

C. Level 2 Controller Description

1. Level 2 controllers shall provide intelligent, standalone control of HVAC, lighting equipment, and plumbing equipment. Each unit shall have its own internal RAM memory and shall continue to operate all local control functions in the event of a failure to any Level 1 controller. In addition, it shall be able to share information with and from the entire network for full global control.

D. Work Station Description

1. The host computer shall be an IBM compatible personal computer. The building automation software shall be capable of communication to all Level 1 and Level 2 controllers, feature high-resolution color graphics, alarming, reporting, and be user configurable for all data collection and data presentation functions. The Level 1 network shall be capable of supporting at least 16 work stations. On systems that are file server based, each work station shall reference a central file server for its database inquiries. On systems that are not file server based any workstation shall be capable of storing system trend data, which shall be accessible from other workstations on the network.

E. Laptop Communications

1. One laptop computer with modem shall be provided. Level 1 and Level 2 controllers shall be capable of communicating directly to a lap top or notebook computer.

F. Web Server Workstation

1. The BAS Contractor shall furnish licenses for (qty.) concurrent users to the BAS system. Web-based users shall have access to all system points and graphics, shall be able to receive and acknowledge alarms, and shall be able to control setpoints and other parameters. A central web server shall be provided to manage the web-based users. The web-based interface must conform to the B-OWS BACnet device profile.

G. System Architecture

1. General: The network architecture shall consist of two levels. The top level shall be a high speed LAN designed to support network controllers, central plant controllers, work stations and a file server and shall operate on the Ethernet protocol. The second level shall be a field bus to support a family of dedicated local controllers for control of HVAC equipment, lighting, and plumbing equipment. The second level bus shall communicate bi-directionally with the high speed LAN through Level 1 controllers for transmission of global data.
2. High Speed LAN: This local area network shall operate at a minimum speed of 100 Mbps. The high speed LAN shall provide transfer of point data, alarms and file activity among Level 1 controllers, work stations and the file server. The high speed LAN shall support a minimum of 50 nodes consisting of Level 1 controllers or work stations.
3. Any data from a Level 2 controller shall also be transmitted onto this LAN through a Level 1 controller. The high speed LAN shall support multi-user communications and multi-session activity. That is, all global data sharing shall occur simultaneously with the transmission of alarm data or user activity.
4. Field Bus: The level 2 bus, or field bus, shall support local control units of modular size for operation of the building's HVAC, lighting and plumbing control systems. The field bus shall operate at a minimum speed of 76.8 kbps, with a minimum length of 4000 feet or 32 nodes before requiring a network repeater.
5. Manufacturers with baud rates of less than 76.8 kbps shall be accepted, but shall be limited to 32 Level 2 controllers to insure adequate global data and alarm response times. The minimum acceptable baud rate shall be 9,600.
6. Network Transparency: All points contained on Level 1 and Level 2 controllers shall be considered global points. Any program in any controller on the network shall be able to reference any point in any controller regardless of its location on the network.
7. Work Station Communications: Work stations shall be connected directly to the high speed LAN. Work stations shall be able to communicate to any Level 1 controller, Level 2 controller, additional work stations or the file server. Work stations shall also be able to communicate via modems to remote controllers. Telephone communications shall operate simultaneously with communication to any controllers connected on the high speed LAN.
8. Laptop Communications: A laptop computer service tool shall communicate with either Level 1 or Level 2 controllers. Through the service tool, operators shall be able

to view points and change parameters on any Level 1 or Level 2 controller on the network.

9. Dial-Up Communications: It shall be possible to access the network remotely through a standard dial-up modem. This modem shall permit direct access to the high speed LAN via a Level 1 controller. It shall be possible to configure multiple modems in Level 1 controllers to enable multi-user communications when more than one telephone line is available. Critical alarms shall be setup by the contractor and approved by the Owners Representative to automatically dial out to a remote operator workstation.
10. Third Party Communications: The network shall be capable of communicating with third party controllers for the system. Two way communications shall be possible with the original equipment manufacturers controllers.

H. Support for Open Systems Protocols

1. All hardware and software included under this section shall conform to BACnet standard 135-2001, to promote interoperability between building subsystems. Additionally, the BAS design must include solutions for the integration of the following "open systems" protocols: LonTalk™, Modbus and digital data communication to third party microprocessors such as chiller controllers, fire panels and variable frequency drives (VFDs).

2.2 BCS – DDC/EMS HARDWARE

A. Level 1 Controllers - General:

1. Level 1 controllers shall perform automated control of HVAC and plumbing equipment and lighting, control peripheral devices, and coordinate communications to other Level 1 and Level 2 controllers in the network.
2. The Level 1 controller shall contain control programs in a combination of EEPROM and battery backed-up RAM. Each Level 1 controller shall have the intelligence to perform all building control strategies, without communication to other controllers, for functions not requiring data from other controllers.
3. Level 1 controllers shall support multi-user communications from workstations and/or locally connected terminals or laptop service tools.
4. Level 1 controllers shall synchronize their resident real time clocks to each controller on the high speed LAN. Additionally, the Level 1 controller shall synchronize the clocks in the Level 2 controllers on its field bus.
5. Input
 - a. The input section of Level 1 controllers shall provide "universal" inputs capable of accepting information on any point in the form of a temperature, voltage ampere, digital, or pulse counter with only a programming command required for differentiation between the input type. No hardware changes shall be required.
 - b. All inputs shall withstand continuous shorting to 120 VAC, 60 Hz power referenced to ground without failure. All inputs shall further be protected to + or - 1500 volts for 50 microsecond transients. All inputs shall have an accuracy of at least + or - 15 mV, and a resolution of 4.8 mV from 0 to 120 degrees F.

- c. Analog Inputs - The Analog Input (AI) function shall monitor each analog input, perform A/D conversion, and hold the digital value in a buffer for interrogation. The A/D conversion shall have a minimum resolution of 12 bits. Input ranges shall be within 0-10 VDC or 4-20 mA.
- d. Digital Inputs - the Digital Input (DI) function shall accept dry contact closures and voltage level transitions. A voltage level below 1 volt shall be read as ON (closed), a voltage level above 3 volts shall be read as OFF (open).
- e. Pulse Accumulator Inputs - the pulse accumulator input function shall have the same characteristics as the DI, except that, in addition a buffer shall be included to totalize pulses between interrogations. Each input shall accept pulses at a minimum of 5 per second.
- f. Temperature Inputs - temperature inputs originating from a thermistor or RTD shall be monitored and buffered as an AI, and provide automatic conversion to degrees F or C without any additional signal conditioning.
- g. Input Wiring - all inputs shall be two wire devices and shall not require shielded wire for accurate operation.

6. Output

- a. Output types shall include digital, universal and tri-state. Outputs shall be available with easily accessible built-in hand-off-auto (HOA) switches for local overrides. DIP switches are not acceptable. Analog output override switches shall be provided with potentiometers to simulate the output range.
- b. Digital Output - the Digital Output (DO) function shall provide contact closure for momentary (Pulse Width Modulation) and maintained operation of field devices. Output pulse width shall be selectable between 0.1 and 3200 seconds with a minimum resolution of 0.1 seconds. Isolation and protection against voltage surges up to 180 VAC peak shall be provided. Contact rating shall be a minimum of 1 amp at 24 VAC. Each digital output shall be equipped with an HOA switch to manually obtain either output state. Manual overrides shall be reported to the controller at each update. An LED shall be provided to indicate the state of each digital output.
- c. Universal Output - a Universal Output shall provide 0-10 VDC, 0-20 mA control signal (with a maximum resolution of .1 volt or .1 mA respectively), and standard Form C relay operation (1 amps, 24 VAC). It shall be possible to select the mode of output operation for each output by simply wiring to the appropriate terminations on the controller. No circuit boards or output cards shall have to be exchanged to select the desired output mode.
 - 1) A three position manual override switch (HOA) shall allow selection of the ON, OFF, or AUTO output state. In addition each universal output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.
 - 2) The Form C output mode shall be capable of standard digital output operation including pulse width modulation.
 - 3) All current outputs shall be fuse protected to 120 VAC.

- d. Tri-State Outputs - tri-state outputs shall consist of two 24 VAC relays for control of bi-directional motors and actuators. Each tri-state output is capable of PWM (pulse width modulation) to a resolution of .1 second.

B. Level 1 Lan-(Ethernet) Based Network Controllers

1. Provide a minimum of 34MB RAM for Ethernet-based controllers. In addition, each controller shall contain a minimum of 2MB of ROM memory for the system firmware. Firmware shall be socketable to allow for future upgrades.
2. Communication Ports
 - a. Network controllers shall provide communication to both the high speed LAN and the field bus. An on-board 10/100bT Ethernet port shall be provided, as well as a RS-485 port for communications to a maximum of 127 MS/TP devices.
 - b. In addition, a minimum of one RS232 and one RS485 port shall be provided for connection to a workstation or laptop service tool. When the port is RS232, it shall support communication to a modem or printer. Where multiple RS232 ports are available, multi-user communications shall be supported.
 - c. Any RS232C ports shall also be usable for connection to tank probes, fire alarm panels, and other microprocessor-based devices, which communicate in ASCII.
3. Communication Protocols
 - a. Ethernet LAN communications are acceptable. The TCP/IP protocol shall be used. Ethernet communications must be fully compliant with IEEE 802.3 and support a full range of off-the-shelf communication devices such as transceivers, bridges and routers.
4. Peer to Peer Communications
 - a. Each Level 1 network controller will be able to exchange information with other Level 1 controllers over the high speed LAN. The network structure shall be transparent such that each controller may store and reference any global variables available in the network for use in the controller's calculations or programs. Each Level 1 controller will also have access to any of the inputs, outputs, and calculated variables contained in Level 2 controllers that is connected to it through its local field bus.
5. Real Time Clock (RTC)
 - a. A battery backed uninterruptible "Real Time Clock", accurate to 10 seconds per month. The RTC shall provide the following information; time of day, day, month, year, and day of week. In normal operation of the system, the clock will be based on the frequency of the AC power. The system shall automatically correct for daylight savings time and leap years.
6. Power Supply
 - a. Level 1 LAN-based network controllers will operate from 120, 240 VAC, 60/50 Hz power, with a tolerance of +/- 20%. Line voltage below the

operating range of the system shall be considered outages. The controller shall contain over voltage surge protection and require no additional AC power signal conditioning. If required by the controller, a transformer to reduce the voltage from 120/220 shall be supplied in the cabinet by the contractor.

7. Automatic Restart After Power Failure

- a. Upon restoration of power, the network controller shall automatically and without human intervention; update all monitored functions, resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

8. Battery Back-Up/UPS

- a. Each Level 1 network controller shall have at least 72 hours of battery backup to maintain all volatile memory. In addition, this battery shall provide for full UPS operation for a minimum of 15 minutes.

9. Indicator Lamps

- a. Network controllers will have as a minimum, LED indication of CPU status, high speed LAN status and field bus status.

10. Local Display

- a. A touch screen LCD display shall be available for every Level 1 LAN-based network controller for readout of point values in the network, and to allow operators to change setpoints and other operating parameters.

11. Packaging

- a. Level 1 network controllers shall be housed in a locking enclosure with external access to the local display. In addition all diagnostic indicator lamps shall be viewable without having to open the enclosure. The enclosure will include knockouts on all sides of the cabinet for connection to field and power wiring.

C. Level 1 - Lan-based Equipment Controllers

1. Memory

- a. A minimum of 256 kB of RAM shall be provided for storing application software and system operation. In addition, each controller shall contain a minimum of 1MB of ROM memory for the system firmware. Firmware shall be socketable to allow for future upgrades.

2. Communication Ports

- a. Level 1 LAN-based equipment controllers shall provide communication to the field bus, and have a RS232 port for a laptop service tool.

3. Network Communications

- a. Each controller will have access to any of the inputs, outputs, and calculated variables contained in Level 2 controllers that are connected to it through its local field bus as well as any other information available on the Ethernet.

4. Real Time Clock (RTC)

- a. The controller shall contain a battery backed uninterruptible "Real Time Clock" accurate to 10 seconds per month. The RTC shall provide the following information; time of day, day, month, year, and day of week. In normal operation, the system clock will be based on the frequency of the AC power. The system shall automatically correct for daylight savings time and leap years.

5. Power Supply

- a. The power supply will operate from 120/220 VAC, 60/50 Hz power, with a tolerance of +20%. Line voltage below the operating range of the system shall be considered outages. The controller shall contain over voltage surge protection, and require no additional AC power signal conditioning. If required by the controller, a transformer to reduce the voltage from 120/220 shall be provided in the cabinet by the contractor

6. Automatic Restart After Power Failure

- a. Upon restoration of power, the Level 1 equipment controller shall automatically and without human intervention; update all monitored functions, resume operation based on current, synchronized time and status, and implement special start-up strategies as required.

7. Battery Back-Up/UPS

- a. Each equipment controller shall have at least 72 hours of battery backup to maintain all volatile memory. In addition, the battery shall provide for full UPS operation for a minimum of 15 minutes.

8. Indicator Lamps

- a. Equipment controllers will have as a minimum LED indication of CPU status, power, field bus status, and error status.

9. Packaging

- a. Equipment controllers shall be housed in a locking enclosure. The enclosure will include knockouts on all sides of the cabinet for connection to field and power wiring.

D. Level 2 Controllers - General

1. Description

- a. Level 2 controllers shall provide standalone control. Each controller shall have its own control programs and will continue to operate in the event of a failure to its associated Level 1 controller.
- b. Control programs shall be stored in battery backed-up RAM and EEPROM. Each Level 2 controller shall have the intelligence to perform all control strategies, without communication to other controllers, for control functions not requiring data from other controllers.

- c. Each Level 2 controller shall be able to have its program edited and/or modified either locally through a laptop computer service tool or through a workstation connected to a Level 1 controller. Each Level 2 controller shall complete its internal scan in less than one second. Each scan shall consist of updating of inputs, importing of data from other controllers, performing mathematical calculations and sequencing appropriate outputs for local loop control.

2. Noise Protection

- a. Level 2 controllers that power with 120 VAC shall permit continuous shorting of any input to 120 VAC. Level 2 controllers that power with 24 VAC shall permit continuous shorting of any input to 24 VAC. All outputs shall be isolated to a minimum of 1500 VAC.

3. Communication Ports

- a. Each controller shall provide communication to the field bus. In addition, a port shall be provided for connection to a laptop service tool to support local programming and parameter changes. It shall be possible from this port to access and program any controller on the field bus, any Master Level controller on the high speed LAN, or any Level 2 controller on a different field bus.

4. Network Communications

- a. Each controller will be able to exchange information between other Level 2 controllers and Level 1 controllers during each field bus scan. The network structure shall be transparent such that each system controller may store and reference any global variables available in the network for use in the local controller's calculations or programs. Each system controller shall be capable of storing and referencing global variables.

5. Automatic Restart After Power Failure

- a. Upon restoration of power, the controller shall automatically and without human intervention; update all monitored functions; resume operation based on current, synchronized time and status, implement special start-up strategies as required.

6. Battery Back Up/UPS

- a. Each Level 2 controller shall have at least 72 hours of battery back-up to maintain all volatile memory. In addition, this battery shall provide for full UPS operation for a minimum of 15 minutes.

7. Indicator Lamps

- a. Level 2 controllers will have, as a minimum, power indication, LED indication of CPU status, and field bus status.

E. Level 2 - System Controllers

1. Description

- a. The Level 2 system controller shall provide direct digital control of hot water and chilled water plants, and all other large systems.

- b. The general requirements of Level 2 controllers apply.
- 2. Memory
 - a. Level 2 system controllers shall have a minimum of 64kB of user RAM memory and 128kB of EEPROM.
- 3. Input/Output
 - a. Inputs - the input section of the system controller shall provide a minimum of 16 universal inputs. Each input shall be configurable through software as a digital (dry contact), analog (0-10V or 4-20 mA), pulse (up to 5 Hz) thermistor, RTD or Thermocouple point. The analog to digital resolution shall be a minimum of 12 bits.
 - b. Outputs - there shall be a minimum of 8 universal outputs configurable as a digital (24 VAC, 1 Amp Form C relays), analog (0 to 10 VDC or 4 to 20 mA), tri-state, or pulse width modulation signal.
 - c. Overrides - each output shall have an easily accessible, built-in, 3-position override switch capable for auto-on-off operation. In addition, each analog output shall also include a potentiometer that can be adjusted manually to override the entire range of the analog signal. DIP switches are not acceptable for overrides.
 - d. Expansion port - the system controller shall have a port to accept a family of I/O modules. Up to two modules shall be powered directly from the power supply of the system controller.
- 4. Real Time Clock (RTC)
 - a. The system controller shall contain a real time clock, accurate to 10 seconds per month. The RTC shall provide the following information; time of day, day, month, year, and day of week. Each controller shall be capable of receiving a signal over the network from the Level 1 controller to synchronize all clocks to the same time.
- 5. Power Supply
 - a. The system controller shall have a built-in, selectable power supply of 120/220 VAC, 50/60 Hz. The power supply will tolerate 20% swings in supply voltage. If required by the controller, a transformer to reduce voltage shall be provided by this contractor with the cabinet.
- 6. Packaging
 - a. System controllers shall be available in either an NEMA 1 rated enclosure or in a package suitable for panel mounting.
- 7. Local Display
 - a. Each system controller shall have a built-in LCD display and keypad. The display shall have a minimum size of 2 lines by 16 characters. From the keypad, operators shall be able to view point status, adjust setpoints and change parameters according to password level.

F. Level 2 - Local Controllers

1. Description

- a. The local controller is designed to provide direct digital control of air handling units, boilers, chillers, water heaters and other equipment.
- b. The general requirements of Level 2 controllers apply.

2. Memory

- a. Local controllers shall have a minimum of 32kB bytes of user RAM memory and 128kB of EEPROM.

3. Input/Output

- a. Inputs - the input section of the local controller shall provide a minimum of 8 universal inputs. Each input shall be configurable through software as a digital (dry contact), analog (0-10V, or 4-20mA), pulse (up to 5 Hz), thermistor, RTD or thermocouple point. The analog to digital resolution shall be a minimum of 10 bits.
- b. Outputs - there shall be a minimum of 8 digital outputs utilizing 24 VAC Form C relays. Each output shall be capable of on/off and pulse width modulation control.
- c. Overrides - each output shall have a built-in override switch capable of auto-on-off operation. DIP switches shall not be acceptable. In addition, each analog output shall include a potentiometer that can simulate the range of the output signal.
- d. Expansion Port - the local controller shall have an optional port to accept a family of I/O modules. Up to two modules shall be powered directly from the power supply of the controller.

4. Real Time Clock (RTC)

- a. The local controller shall contain a real time clock, accurate to 10 seconds per month. The RTC shall provide the following information; time of day, day, month, year, and day of week. Each controller shall be capable of receiving a signal over the network from the Level 1 controller to synchronize all clocks to the same time.

5. Power Supply

- a. The local controller shall have a built-in power supply of selectable 120/220 VAC, 50/60 Hz. The power supply will tolerate 20% swings in supply voltage. If required by the controller, a transformer to reduce voltage shall be provided by this contractor within the cabinet.

6. Packaging

- a. Local controller shall be provided in either an NEMA 1 rated enclosure.

7. Local Display

- a. Local controllers shall have a built-in LCD display and keypad. The display shall have a minimum size of 2 lines by 16 characters. From the keypad, operators shall be able to view point status.

G. Level 2 - Terminal Equipment Controllers

1. Description

- a. The terminal equipment controller is designed to provide direct digital control of variable air volume boxes, heat pumps, unit ventilators, and fan coil units.
- b. The general requirements of Level 2 controllers apply.

2. Memory

- a. Terminal equipment controllers shall have a minimum of 32kB bytes of user RAM memory and 128kB of EEPROM.

3. Input/Output

- a. Inputs - the input section of the terminal equipment controller shall provide a minimum of 6 universal inputs. Each input shall be configurable through software as a digital (dry contact), analog (0-10V or 4-20mA), pulse (up to 5 Hz) thermistor, RTD or thermocouple point. The analog to digital resolution shall be a minimum of 10 bits. A fifth input shall be available for measuring air flow. The air flow sensor shall be included as part of the controller, and accurate to +5% over a range of 0 to 1 inch w.g.
- b. Expansion port - the terminal equipment controller shall have an optional port to accept a family of I/O modules. Up to two modules shall be powered directly from the power supply of the terminal equipment controller.
- c. Provide at least 3 on board potentiometers to set the maximum and minimum values of VAV equipment.
- d. Overrides - Each output shall have a built-in override switch capable of auto-on-off operation. DIP switches are not acceptable. Analog outputs overrides shall be equipped with potentiometers to simulate the range of the output.

4. Power Supply

- a. The terminal equipment controller shall have a built-in power supply of 24 VAC, 50/60 Hz. The power supply will tolerate 20% swings in supply voltage of 120/220 VAC.

5. Packaging

- a. Terminal equipment controllers shall be available in a package suitable for panel mounting.
- b. Outputs - There shall be a minimum of one form A relay, one form K relay and one analog (0-10V or 4-20mA) outputs.

H. Level 2 - I/O Expansion Modules

1. Description

- a. Expansion modules are designed to increase the amount of I/O available to each system, local or terminal equipment controller above its base level. Module types shall include as a minimum digital inputs, digital outputs, analog outputs, and pneumatic outputs. It shall be possible to add up to two modules of any type to Level 2 controllers having an expansion port. There will be no limitations in software placed upon any points that originate from expansion modules.
 2. Input Modules
 - a. Input modules shall contain 8 digital inputs.
 3. Output Modules
 - a. Each module shall provide either two digital, analog or pneumatic outputs. Digital outputs shall be available in either 24 VAC or 120 VAC/220 VAC rated relays. Analog outputs shall provide either 0-10 VDC or 4-20 mA. Pneumatic outputs shall provide a 3-15 psi signal, with built-in feedback of the branch pressure. All output modules shall include easily accessible 3 position override switches and potentiometers. (DIP switches shall not be acceptable).
- I. Operator Workstations, Web Servers and File Servers
 1. Workstations, Web Servers:
 - a. As a minimum, the single user workstation shall be provided. The workstation shall consist of the following:
 - 1) 3 GHZ Pentium 4 processor with 1GB of RAM
 - 2) Microsoft Windows XP™ operating system
 - 3) Serial port, parallel port, USB port
 - 4) 10/100MBPS Ethernet NIC
 - 5) 80 GB hard disk
 - 6) CD-RW Drive
 - 7) High resolution (minimum 1280 x 1024), 17" flat panel display
 - 8) Optical mouse and full function keyboard
 - 9) Audio sound card and speakers
 - 10) License agreement for all applicable software
 - b. The CPU and all substations shall be capable of operation in an environment of 50-90 F with 20-80% non-condensing relative humidity.
 2. File Server
 - a. As a minimum, the file server shall be provided. The fire server computer shall consist of the following:
 - 1) 3 GHz Pentium 4 processor with 1GB of RAM
 - 2) Microsoft Windows 2000 Server™ operating system
 - 3) 10/100MBPS Ethernet NIC
 - 4) 80 GB hard disk
 - 5) CD-RW drive
 - 6) High resolution (minimum 1024 x 768), 17" flat panel display
 - 7) Mouse, full function keyboard
 - 8) License agreement for all applicable software

- b. The CPU and subsystems shall be capable of operation in an environment of 50 -90 F and 20-80% non-condensing relative humidity.

3. Web-Based Operator PC Requirements

- a. Any user on the network can access the system, using the following software:
 - 1) Windows 2000/XP
 - 2) Internet Explorer 6.0 and above
 - 3) Java-enabled

J. Laptop Service Tool:

- 1. The laptop computer will be provided. The laptop computer shall consist of the following:
 - a. 3 GHz Pentium 4 processor with 1GB of RAM
 - b. Microsoft Windows XP operating system
 - c. Serial port, parallel port, USB port
 - d. 40 GB hard drive
 - e. CD-RW drive
 - f. License agreement for all applicable software
- 2. The laptop computer will have an integral color display with a port for connection to an external SVGA monitor.
- 3. The laptop computer shall be equipped with a field bus interface card for connection to any wall mounted sensor equipped with a service jack, a Level 1, or Level 2 controller.
- 4. One laptop service tool shall be provided for use by the balancing contractor until project is complete. The computer will become the property of the Owner when the project is complete.
- 5. Provide a bell compatible 56Kbaud auto answer modem on to the network. Once accessing the BAS via the modem, an operator shall have full access, to the limit of his password, to the entire network.

K. Network Devices

- 1. Repeaters
 - a. Level 1 High Speed LAN - repeaters shall be available in single point and multiple point configurations. Multi-point repeaters (hubs) shall be modular to allow support for mixed media applications. When repeaters are mounted in a Level 1 Network Controller, power shall be obtained directly from the controller, allowing a repeater to function from the built-in UPS of the controller during power outages.
 - b. Level 2 Field Bus - the field bus driver will provide amplification to allow for expansion beyond 32 Level 2 controllers or 4000 feet. For each additional group of 32 controllers or 4,000 feet, and additional driver will be required. Drivers that can provide multiple channels from a single card are acceptable. Provide field bus drives that convert RS485 twisted pair communications into RS232C duplex fiber optics.

2. Network Interface Cards
 - a. The network interface card shall provide connection to the Ethernet-based high speed local area network. Ethernet cards shall be available in coax, fiber optic or twisted pair depending on the media used.
3. Bridges
 - a. For Ethernet based networks, the system shall be compatible with both local and remote bridges for the purpose of isolating networks, and routing information to distant locations over high speed phone lines. Local bridges must be capable of line speed throughput.
- L. Printer
 1. Provide a laser graphics printer with the single user workstation and with the file server. The printer shall be able to print on both 8½" x 11" and 11" x 17" paper. Printer speed shall be 6 pages per minute minimum.
- M. Tape Backup
 1. Tape backup shall be DAT (Digital Audio Tape) with a minimum of 8 GB storage capacity.
 2. Backup speed shall be a minimum 15 MB per minute.
- N. BacNet Gateway to Third-Party Devices
 1. General
 - a. Where required, provide a BACnet Gateway to interface to non-BACnet systems that use the Modbus protocol, LONworks protocol or other proprietary protocol. The Gateway shall communicate directly over Ethernet TCP/IP and shall use the BACnet/IP protocol to communicate with a BACnet Workstation (B-OWS).
 2. Communication Ports
 - a. In addition to its on-board Ethernet port, the Gateway shall have at least two serial communications ports for interfaces to third-party systems.
 3. Memory
 - a. The Gateway shall have enough RAM memory to store all point configuration data, plus required history logging and alarm buffering. Minimum RAM shall be 8 MB. The operating system of the gateway must be stored in FLASH non-volatile memory.
 4. User Programming Language
 - a. The Gateway shall employ the same user programmable application software that NRCs and SDCUs use.
 - b. Control software, mathematical functions and energy management applications must be identify to that which is provided with the Network Router/Controller. Gateways that do not have an application programming language will not be accepted.

5. History Logging

- a. Each Gateway shall be capable of LOCALLY logging any input, output, calculated value or other system variable over user defined time intervals ranging from 1 second to 1440 minutes. Any system can be logged in history. A minimum of 1000 values shall be stored in each log. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to the Operator Workstation for long-term archiving based upon user-defined time intervals or manual command.

2.3 BCS SOFTWARE

A. Network Drivers

1. Description: Network drivers shall be available to provide amplification and media conversion for both the high speed LAN and the field bus. These network drivers shall operate as active hubs, rebroadcasting the bus communications to the various controllers downstream from the driver.
2. High Speed LAN:
 - a. Drivers shall be available for twisted pair cabling, coaxial cabling, and fiber optic networks.
 - b. Coaxial drivers shall support both bus and star network topologies. Fiber optic and twisted pair drivers shall operate in star topologies.
 - c. Drivers shall be configurable for location in a single controller or in modular hubs with expansion up to 16 links.
3. Field Bus: The field bus driver shall provide amplification to allow for expansion beyond 32 nodes or 4000 feet. For each additional group of 32 nodes or 4000 feet, an additional driver shall be required. Drivers that can provide multiple channels from a single card are acceptable.

B. Level 1 Controller Software

1. Software Description: The application software shall be configured for each Level 1 controller either locally, through a laptop computer service tool, or through a work station. Level 1 controllers shall contain PROM as the resident operating system. Application software shall be RAM resident. Application software shall only be limited by the amount of RAM. There shall be no restrictions placed on the type of application programs in the system.
 - a. Each Level 1 controller shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function by Level 1 controllers shall not be interrupted due to normal user communications including; interrogation, program entry, printout of the program for storage, etc.
2. Real-Time Operating System: Provide a real time operating system in PROM memory requiring no operator interaction to initiate and commence operations. The program shall include:

- a. Operation and management of all devices
 - b. Error detection and recovery from arithmetic and logical faults
 - c. Editing software to allow the user to develop or alter application programs
 - d. System self-testing
 - e. Multi-user
 - f. Multi-tasking
3. Editor: When programming a controller through either a work station or laptop computer, editing and word processing features shall include as a minimum:
- a. Cut, copy, paste, and undo
 - b. Search and replace
 - c. Comments
 - d. Scrolling
 - e. Character, line, and page cursor control
4. When programming in terminal mode, the system shall allow full screen, character editing for correction or modification of any portion of a program. Syntax errors shall be highlighted, and programmers must make corrections prior to the program being compiled.
5. When programming Level 2 controllers, the programming environment shall be identical to Level 1 programming with automatic uploading and downloading of the compiled code to the controller.
6. Point Identification: Users must be able to assign unique identifiers for each connected point. Identifiers must have at least sixteen alpha/numeric characters. All references to these points in programs, reports, and command messages shall be by these identifiers.
- a. Each point name can have up to a 32 character description or engineering units (up to 8 characters).
 - b. The BCS contractor shall submit a list of all point names to the Owner's Representative for approval prior to programming the system.
7. User Programming Language: The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be English language and programmable by the user.
- a. The language shall be structured to allow for the easy configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, passwords, and histories.
 - b. The language shall allow the creation of timers anywhere in the logic of a program. Each timer shall increment in seconds and increment to a minimum of 365 days.

- c. The language shall be self-documenting. Users shall be able to place comments anywhere in the body of a program. Program listings shall be configurable by the user in logical groupings.
- 8. Application Software: The system shall contain ROM based, built-in software modules for the creation of standard application programs. Modules shall include as a minimum:
 - a. PID Algorithm
 - b. Self-Tuning PID
 - c. Calendar Functions (Seconds, minutes, hour, day of week, day of month, day of year, month and year)
 - d. Curve fit
 - e. Optimum Start
- 9. Mathematical Functions: Each controller shall be capable of performing basic mathematical functions, squares, square roots, exponential, logarithms, Boolean logic statements, or combinations.
- 10. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.
- 11. Passwords: Level 1 controllers shall have 5 levels of passwords. The highest level shall allow access to all functions within the system. The remaining 4 levels will be definable by the Owner to include any subset of system commands.
- 12. History Logging: Each controller shall be capable of logging any system variable over user defined time intervals ranging from 1 second to 365 days. Any system variables (inputs, outputs, math calculations, flags, etc.) can be logged in history. A minimum of 32767 values may be stored in each log. Each log shall record either the instantaneous, average, minimum or maximum value of the point. Logs can be automatic or manual.
 - a. It shall be possible to find the average of a log, the standard deviation, the sum, minimum or maximum. It shall also be possible to reference any value within a log for use in a control program.
- 13. Reporting: The system shall be able to create user definable reports containing any combination of text and system variables. Report templates will be created by users in a word processing environment. Reports can be displayed based on any logical condition or through a user command.
 - a. Numerical displays shall be up to 8 digits in total length, with up to 8 digits to the right of the decimal point. The format of each numerical display shall be user definable.
- 14. Alarming: For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms shall be tested. Each alarm can result in the display of one or more alarm messages or reports. Messages and reports can be

sent to the display panel, a local terminal, to the Work Station, via modem to a remote computing device, or all of the above.

15. Overriding Programs: It shall be possible to disable any point in the system and modify it to a user definable value. Any points that have been disabled shall be kept in a log and viewable by an operator at any time.
16. I/O Configuration: All input, output, and internal software points shall be configurable from menus in the operator workstation and laptop service tool connected to a Level 1 network or remote site master controller. Each input shall be software selectable to operate as a digital point, analog voltage, analog ampere, analog resistance, temperature sensor, or a pulsed signal. Each output point shall be software selectable to operate as a digital, analog or tri-state. The software shall permit scaling of analog inputs and outputs in engineering units, with automatic conversions for both linear and non-linear devices.

C. Work Station Software

1. Software Description: Work station functions shall include monitoring and programming of Level 1 and Level 2 controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
2. The work station software shall be able to communicate to all Level 1 and Level 2 controllers, and where necessary integrate information that is common to one or more controllers.
3. The software shall be oriented towards operators and programmers. In the operator's mode, all information will be available in graphic and text displays. Graphic displays shall feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the system.
4. All operator functions shall be selectable through a mouse. A "windows" environment shall be used to allow multiple functions to be displayed on the screen simultaneously.
5. Operating System: The software shall utilize a multi-user, multi-tasking operating system or equivalent. An environment operating over a non-multi-tasking operating system shall not be acceptable. Provide LAN management software for operation of a common database on the file server.
6. Network Communications: The network consists of a high speed LAN comprised of Level 1 controllers, work stations and a file server. The file server shall act as the central database for the work stations, so that all additions or changes made by one operator are immediately available to other operators on the network.
7. System Database: The work station database shall consist of all points and programs in each of the controllers that have been assigned to the network. In addition, the database shall contain all work station files including graphic slides, alarm reports, text reports, historical data logs, schedules, and polling records. The software shall conform to the following:
8. Whenever a new controller is added to the system, the software shall automatically update that controller with its assigned points and programs. The system shall also be able to verify that the point database in each controller is identical to the one at

the work station. If any discrepancy is found, it shall automatically modify its database or notify an operator of the error.

9. Web-based Operator Software

a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network. Access to the system must be available from a dial-in connection over the Internet.

10. The database shall also contain host level points consisting of variables, which can be used for host level reports and alarming. These variables can be setpoints or the result of any Boolean algebra expression.

11. Object Tree: It shall be possible for an operator to view the entire database through a graphical object tree display. This tree will present all controllers and their associated points, programs, graphics, alarms, and reports in a easy to understand structure.

12. System Configuration: Configuration of the database shall be through application modules, each having a unique "icon" for easy visual identification. Each module shall provide a windowed menu in which to enter the required data base information. System configuration shall have the following features:

13. Each site, whether local or remote, shall have a separate record for storing pertinent communication parameters.

14. Controllers shall be associated with a specific site file. The controller record shall also contain the controller passwords and communication logon and logoff text strings as required.

15. Point records shall include as a minimum a 32 character point description, engineering units, logging parameters, point status, and point value.

16. All database records shall be available to the user at all times, regardless of the current tasks being performed by the work station.

17. Color Graphic Displays: In addition to the graphics provided by the BCS contractor, the system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse. Requirements of the color graphic subsystem include:

a. The user shall have the ability to import CAD generated drawing files as background displays. Updates to imported CAD drawings shall not affect work station added animations.

b. A library of built in stencils, symbols and display shapes common to the HVAC, Electrical, and Plumbing industries.

c. An on-line graphics drawing editor that provides for all standard geometric shapes, multiple line thicknesses, shading, up to 256 colors, cutting and pasting of objects, inclusion of text, and zooming.

- d. Built-in control panel objects such as buttons, knobs, gauges, line graphs, etc. to enable operators to interact with the graphic displays in a manner that mimics their equivalents found on field installed control panels.
 - e. Status changes or alarm conditions shall be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.
 - f. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators shall be able to move from one graphic to another by selecting an object with a mouse, no menus shall be required.
 - g. The graphic system shall allow for one touch modification of any analog or digital point in the database regardless of its location in the network.
 - h. The clarity of the graphic sequence shall be such that the user will have the ability to verify that the control loop programming meets the specifications without having to interpret the system manufacturer's program.
 - i. The software shall include, but shall not be limited to the following:
 - 1) Both color graphics and point information blocks, which can be commanded from the screen by simply clicking on the symbol with the mouse.
 - 2) Setpoints, which can be changed on the screen by clicking on and moving a slide bar with the mouse.
 - 3) Graphic symbols and point information blocks, which change color to indicate current point status.
 - 4) Dynamic graphics, which can be initiated by typing the name, clicking the name found in a pull-down menu, or asking for the graphic containing a specific point.
 - 5) Graphics, which can be linked by clicking on a symbol allowing systems to be viewed in successively greater details.
 - 6) The current alarm count, which is always displayed on the screen with both visible/audible annunciation being selectable.
 - 7) From the alarm window, the operator shall be able to load a graphic or display a message associated with a point that has gone into alarm in order to troubleshoot the alarm.
 - 8) All commands supported by an application are provided in pull-down menus on the screen to free the user from ever having to memorize commands.
 - 9) The operator's initials are to be displayed on all reports and alarm acknowledgments.
18. The BCS contractor shall provide graphics at the user workstation that display at least the information indicated on the control diagrams in the drawing package. Additionally, the graphics shall contain the following information for each device:

- a. Two position control devices including valves, dampers, constant volume pumps (fans).
 - 1) Control signal status.
 - 2) Feedback device status (end switches, differential pressure switches).
 - b. Modulating control devices including valves, damper, variable flow pumps (fans).
 - 1) Control signal status.
 - 2) Feedback device status (pilot positioner % open, end switches, differential pressure switches).
 - 3) VFD output (voltage, amperage, frequency)
 - 4) VFD alarms.
 - c. Analog Field Devices
 - 1) Control Setpoint
 - 2) Process Variable Reading
 - 3) Output signal (% open etc.)
 - 4) Positioner feedback
 - d. Digital Field Devices
 - 1) Control Setpoint
 - 2) Device Status (on/off, open/closed)
 - e. Monitoring Devices
 - 1) Process Variable Reading
 - f. Equipment Manufacturer's Control Panels
 - 1) All equipment (mechanical, electrical and plumbing) controlled by the Equipment Manufacturer Packaged Controller shall be monitored by the BCS. All process variables capable of being transmitted by the Manufacturer's Controller shall be displayed adjacent to the graphic symbol of the equipment.
19. Where applicable, all readings, setpoints and conditions shall be expressed with their engineering units (i.e., temperature shall be expressed in degrees Fahrenheit). By use of a function key on the keyboard, the user shall be able to toggle between SI units and English units. The program shall contain all necessary conversion factors accurate to two decimal places. Graphics shall be a minimum of six (6) colors in display of various systems.
20. Automatic Monitoring: The software shall allow for the collection of data and reports from any Level 1 or Level 2 controller through either a hardwire or modem

communication link. The time schedules and content of the polling shall be user configurable and include any subset of the controller's data base including application programs.

21. Alarm Management: The software shall be capable of both accepting alarms directly from Level 1 controllers, or generating alarms based on polling of data in controllers and comparing to limits or conditional equations configured in the host software. Any alarm (regardless of its origination) shall be integrated into the overall alarm management system and shall appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, reports, or initiating communication to another controller or remote computing device. Alarm management features shall include:
 - a. A minimum of 255 alarm levels. Each alarm level shall establish a unique set of parameters for controlling alarm display, acknowledgment, keyboard annunciation, alarm printout and record keeping.
 - b. When an alarm occurs the Alarm counter shall be incremented by one.
 - c. Printout of the alarm or alarm report to an alarm printer or report printer.
 - d. Print the alarm acknowledgment or Return to Normal message.
 - e. Sound an audible beep on alarm initiation or acknowledgment.
 - f. It shall be possible to direct alarm displays to all or any of 16 groups of work stations on the network. Each configured path can be assigned on a unique basis to individual alarm levels.
22. Report Generation: The software shall contain a built-in report generator, featuring word processing tools for the creation of custom building reports.
 - a. Reports can be of any length and contain any points with the database of Level 1 and Level 2 controllers.
 - b. The report generator shall have access to the user programming language in order to perform mathematical calculations inside the body of the report, control the display output of the report, or prompt the user for additional information needed by the report.
 - c. It shall be possible to run other executable programs whenever a report is initiated.
 - d. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.
23. Scheduling: It shall be possible to configure and download from the work station schedules for any of the controllers on the network.
24. Time of day schedules shall be in a calendar style configured for either monthly or weekly operation. Scheduling shall be programmable up to one year in advance.
25. Each schedule shall appear on the screen as a monthly calendar correctly showing the day, weekday, month and year. It shall be possible to scroll from one month to the next and view or alter any of the schedule times.

26. Schedules shall be assigned to specific controllers and stored in their local RAM memory. Any changes made at the work station shall be automatically updated to the corresponding schedule in the controller.
27. It shall be possible to configure multiple Holiday schedules in a yearly format. Holiday schedules shall override the standard operating schedule for those days that have been defined as holidays. Holidays shall be differentiated on the calendar through color coding of the date. Any changes to a holiday schedule shall be automatically updated to the standard schedule to which it has been superimposed.
28. There shall also be a provision for Special Day schedules. Special Day schedules shall override both the standard schedule and its associated Holiday schedule. Special Days shall be differentiated on the calendar through color coding of the date. Any changes to a Special Day schedule shall be automatically updated to the standard schedule to which it has been superimposed.
29. The Scheduling application shall include built-in editing tools to permit users to copy and paste portions of schedules to different days, weeks or months. Users can select from a particular day, a range of days, or a non-consecutive group of days over which to edit a schedule.
30. Trending: The software shall be capable of displaying historical data in either a tabular or graphical format. The requirements of this trending capability shall include the following:
 - a. Any field point or calculated variable shall be available for trending.
 - b. In a tabular form, the trend display can have up to 16 columns. Each column shall contain a minimum of 6500 rows.
 - c. In the graphical format, the trend shall plot up to 16 separate variables over the requested time period.
 - d. The time period for each trend shall be user selectable, from 1 minute to 1 year.
 - e. When using the tabular form, the user shall be able to select from displays that show the actual value at each interval, the interpolated value, or the value of the last change.
31. Programmer's Environment: The programmer's environment shall include access to a superset of the same programming language supported in the Level 1 controllers. Here the programmer shall be able to configure application software off-line (if desired) for custom program development, write global control programs, system reports, wide area networking data collection routines, and custom alarm management software.
32. Security:
 - a. The software shall employ a two tiered password system. The first tier shall consist of the user's name. The second tier shall be a unique password consisting of up to 8 alphanumeric characters.
 - b. Each password shall have a unique access level. At least 5 levels shall be defined as follows:

- 1) Custodial - View all applications, but perform no database modifications
- 2) Clerical - Custodial privileges plus the ability to acknowledge alarms
- 3) Operator - All privileges except system configuration
- 4) Engineering - All privileges except password assignments and modifications
- 5) Administrative - All privileges

33. Saving/Reloading Programs:

- a. The work station software shall have an application to save and restore field controller memory dumps. The site and device record files shall serve as a menu tree to coordinate save/reload records. Each record shall have a minimum 12 character record name and a 32 character description.
- b. The Save/Reload application shall have the capability to set the system clock in a Level 1 controller.
- c. Default values store in the work station database shall be sent to the controller during a reload operation either automatically or at the user's option.
- d. If during a poll of a controller, the work station determines that the controller program has been lost, it shall be possible for the work station to automatically reload the program without operator involvement.

D. Level 1 - Lan-based Network Controllers

1. Software Configuration: LAN-based network controllers may be configured through a terminal, laptop computer or through a workstation. When using a terminal, the operator shall be able to configure the entire system through built-in menus and a full screen editor.
2. Real-Time Operating System: Provide a real time operating system in EPROM memory requiring no operator interaction to initiate and commence operations. The program shall include:
 - a. Operation and management of all devices.
 - b. Error detection and recovery from arithmetic and logical faults.
 - c. Editing software to allow the user to develop or alter application programs.
 - d. System self-testing.
 - e. Multi-user capability.
 - f. Multi-tasking capability.
3. Reporting: It shall be possible to create user definable reports in network controllers containing any combination of text and system variables. Report templates will be created by users in a word processing environment. Report can be displayed based on any logical condition or through a user command. Numerical displays shall be up

to 8 digits in total length, with up to 8 digits to the right of the decimal point. The format of each numerical display shall be user definable.

4. Programmable Drivers: Using the programming language specified herein, it shall be possible to develop specific ASCII-based software drivers in the Level 1 Network Controllers for communication to fire panels, chiller panels and other similar devices. These drivers should be capable of bi-directional communications, and all information obtained shall be available over the network for utilization in operator displays and local control programs.

E. Level 1 - Lan-based Equipment Controllers

1. Software Configuration: LAN-based equipment controllers may be configured through a laptop computer or through a workstation.
2. Real-Time Operating System: Provide a real time operating system in EPROM memory requiring no operator interaction to initiate and commence operations. The program shall include:
 - a. Operation and Management of All Devices.
 - b. Error Detection and Recovery from Arithmetic and Logical Faults.
 - c. System Self-Testing.
 - d. Multi-User Capability.
 - e. Multi-Tasking Capabilities.
3. Application Programs: Utilizing the user programming language specified above, application specific programs will be developed for each Level 2 controller including but not limited to start/stop sequences, valve and damper modulation, equipment optimization, energy management routines, and safety interlocks.
4. Alarming: For each system point, up to 8 alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan and can result in the display of one or more alarm messages or reports through a host work station.
5. History Logging: Each controller shall be capable of logging any point over user defined time intervals ranging from 1 second to 365 days. Points include inputs, outputs, math calculations, setpoints, and internal variables. A minimum of 2000 values can be stored in each log. Each log will record either the instantaneous, average, minimum, or maximum value of the point. Logs can be automatic or manual.
6. Schedules: Time schedules configured at an operator workstation are to be stored in the Level 2 controller. Each schedule shall have multiple start and stop times per day, automatically adjust for holidays, day light savings and leap years. The number of schedules per Level 2 controller will be limited only by available memory.
7. Expansion Modules: There will be no special programming required when assigning points originating from an expansion module. In addition, there shall be no limitations on application programs that reference points from expansion modules.
8. Overriding System Points: It shall be possible to disable a point in a Level 2 controller and modify it to a user definable value. Any points that have been disabled will be kept in a log and viewable by an operator at any time.

F. Level 2 Controllers

1. All input, output, and internal software points shall be configurable from menus in the operator workstations, the laptop service tool, or through a dumb terminal connected to a Level 1 network or remote site master controller. Each input shall be software selectable to operate as a digital point, analog voltage, analog ampere, temperature sensor, or a pulsed signal. Output point types may include digital, analog or tri-state. The software shall permit scaling of analog inputs and outputs in engineering units, with automatic conversions for both linear and non-linear devices. Where Level 2 controllers contain override switches, the software shall detect the override position of the switch and record the actual value of the override for both digital and analog output types.
2. Data Identification: Users must be able to assign unique identifiers for each connected I/O point, variable, or controller in the system. Identifiers may have up to sixteen (16) alpha/numeric characters. All references in the programs, reports, and command messages shall be by these identifiers. Each point name can have up to a 40 character description, and engineering units (up to 8 characters). All analog points shall be stored as floating point numbers and displayable in integer or scientific notation formats.

G. Level 2 - System Controllers

1. Description: System controllers shall contain all of the function of a Level 2 controller specified above. In addition, these controllers shall contain software support for the real time clock and the optional LCD display.
2. Local Display: All points and system variables contained in the system controller shall be displayable through the optional LCD display. In addition, it shall be possible through a keypad to modify variables such as setpoints and operating parameters. The software will allow any point to be selectively removed from access through the display.

H. Level 2 - Local Controllers

1. Description: Local controllers shall contain all of the function of a Level 2 controller specified above. In addition, these controllers will also contain software support for the real time clock and the optional LCD display.

I. Level 2 - Terminal Equipment Controllers

1. Description: Terminal equipment controllers shall contain all of the function described for Level 2 Controls above. Terminal equipment controllers that have ROM-based application software are unacceptable.

2.4 FIELD DEVICES

A. Input Devices

1. The system shall maintain the specified analog end-to-end accuracy throughout the warranty period from sensor to controller readout.
2. Transducers may be supplied as an integral unit with the field sensor, or mounted separately in a field interface panel, or as part of the controller. All transducers shall be calibrated in the field for mounting and connected to the final terminations.

3. Sensors and transducers shall be appropriately packaged for the location.
 - a. Architectural housing for space mounting
 - b. Weatherproof/sunshield housing for outdoors
 - c. Thermal well housing for water applications
 - d. Protective housing for duct mounting
4. The sensor/transducer shall be selected to withstand ambient conditions where:
 - a. Moisture or condensation is a factor
 - b. Vibration exists from ductwork, equipment, etc.
 - c. Reasonably expected transient conditions exist for temperatures, pressures, humidities, etc. outside the normal sensing range
5. The sensor/transducer shall be appropriately selected to most closely match the expected sensing range. If, upon start-up and balancing, a sensor/transducer is operating below 20% or above 80% of its range, the sensor/transducer shall be replaced at no additional cost with a unit of an appropriate range such that the measured value is between 30% and 70% of the range.
6. System accuracy of sensed conditions shall be as follows:
 - +/- 0.5 F for space temperature in the 0 - 130 F range
 - +/- 0.5 F for duct temperatures in the 40 to 130F range
 - +/- 1.0 F for outside air temperatures in the -30 to 230 F range
 - +/- 1% of reading for KWH and KW monitoring
 - +/- 2% RH for relative humidity in the 10 to 90% range
 - +/- 0.1 inches for static pressure over 0-5 inch water gauge
 - +/- 0.05 inch for filter status differential over a 0- 2 inch range
 - +/- 1% of reading for pressure switches and sensors
 - +/- 1% of reading for air flow
 - +/- 1% of reading for differential water pressure
 - +/- 1% of span for level
7. Sensors in the return or discharge duct shall be of the single point type. Sensors in the mixed air shall be of the averaging type.
8. Thermowells shall be brass or steel for non- corrosive fluids below 250 deg. F and 300 series stainless steel for all other applications.
9. All digital inputs shall be provided by dry contacts. The contacts shall be wired normally open or normally closed as required.
10. Temperature sensors shall be by the use of thermistors or Resistance Temperature Detectors (RTD).
11. Motor status shall be monitored by current sensing switches.
12. Utility metered or submetered KWH or KW shall be sensed by a pulse producing transducer.

13. Provide differential pressure sensors and transmitters as follows:
 - a. Differential pressure sensors shall withstand up to 150% of rated pressure with an accuracy 1% of full scale, including non-linearity, hysteresis, and repeatability. Sensors shall have transmitters with outputs compatible with system. Sensors shall be industrial grade.
 - 1) Duct mounted airflow differential pressure sensors used for measuring supply duct static pressure for VAV applications, shall have a range of 0.0" to +5.0" WC. Sensors for measuring building static pressure shall have a range of -0.3" to +0.3" WG.
14. Room sensors shall be as follows:
 - a. Sensing element only. (Public Areas)
 - b. Sensing element, setpoint adjustment, override switch. (Open Offices)
 - c. Sensing element, setpoint adjustment, override switch and LCD display. (Closed Offices)
 - d. Room sensors shall have tamper-proof housing.
 - e. Room thermostats and transmitters shall be miniature, two-pipe with pneumatic relay, pneumatic feedback, adjustable sensitivity and calibrated dial.
 - f. Thermostats in public and multi-occupancy areas shall have metal cover with tamper proof screws and satin chrome finish, with concealed adjustment, without thermometer.
 - g. Thermostats for private offices and single occupancy areas shall have open adjustment for use with key, exposed dial and accurate red-reading thermometer.
 - h. Transmitters shall have closed adjustment.
 - i. Room thermostats shall be of heavy duty, all-metal.
 - j. Heating/cooling thermostats shall be deadband.
 - k. Modulating room transmitters shall be tamper proof. Transmitters shall have concealed adjustable setpoints. Thermostat shall be solid state with nominal 1000 ohm linear nickel wire sensing element. Element shall have positive temperature coefficient. Temperature limits shall be 0 to 125° F with operating range of 55 to 85° F. Accuracy shall be ∇ 1%.
 - l. Two position room thermostats shall be tamper proof without thermometers. Thermostat shall have concealed adjustable setpoints. Sensing elements shall be liquid charged.
 - m. Thermostats in public and multi-occupancy areas shall be tamper proof screws and satin chrome finish, with concealed adjustment without thermometer.

- n. Thermostats for private offices and single occupancy type areas shall have open adjustment for use with key, exposed dial and accurate red-reading thermometer.
- o. Room thermostats shall be of heavy duty, all metal.
- p. Heating/cooling thermostats shall be deadband.
- q. Refer to drawing and/or points list for sensor type and location.
- 15. Current to pneumatic (I/P) transducers shall have an accuracy of 1% (including linearity, hysteresis, and repeatability), over their ranges.
- 16. All components located in explosion-proof (four hour rated) rooms shall be intrinsically safe explosion-proof components. Refer to drawings for locations of these rooms.
- 17. Air flow status shall be sensed by static differential pressure sensor or switch piped across all fans (low-port to fan suction, high-port to fan discharge). Where status indication is required across VAV or 2 speed fan, provide analog static differential pressure sensor for accurate status indication at minimum speed or VAV discharge.
- 18. Common alarms shall be wired relay coils in parallel with common alarm pilot light. Contacts shall input to BCS.
- 19. Wire contacts normally open (NO). When in an alarm condition the contact shall open and the BCS shall sense alarm condition.
- 20. Provide a minimum of two digital inputs from each smoke control FFOP (Fire Fighter's Override Panel) switch. Do not generate interlock sequences and printouts without the Owner's Representative approval. All control wiring between the FFOP and BCS panel, motor starters, and controlled devices shall be performed under the work of this section. This includes wiring the indicator lights at the FFOP and smoke control contacts for each zone from the fireman's control center.
- 21. Connect to alarm outputs of clean room AC units, plumbing pump stations, condensate pump sets, and desiccant dehumidifiers.
- 22. Air flow transducers for volume control terminals shall have the ability to control air flow with a velocity pressure signal of 0.02" WC or less with an accuracy of +10% of reading.

B. Output Devices

- 1. The use of multiplexers will not be accepted.
- 2. All digital outputs shall be electrically isolated from the digital controller by interface relays.
- 3. Field relays shall have a minimum life of 1 million cycles without failure.
- 4. Electric to pneumatic transducers (E/P) shall operate from an analog signal. E/P transducers shall be rated for 0 -20 PSIG operation and accurate to 1% of full scale. E/P transducers shall have a maximum air consumption of 100 SCIM.
- 5. Electric solenoid operated pneumatic valves (EP's) shall have a three port operation: common, normally open and normally closed. They shall be rated for 50 psig when

used for 25 psig or less applications, or rated for 150 psig when used for 100 psig or less applications. The coils shall be equipped with transient suppression devices to limit transients to 150 percent of the rated coil voltage.

C. Actuators

1. General Application of Actuators:
 - a. Actuators for valves and dampers 2 ½" and larger, greater than 8 ft² shall be pneumatic.
 - b. Actuators for valves and dampers servicing terminal equipment (i.e. reheat coil valves, fan coil unit valves, variable air volume boxes, etc.) May be electric or pneumatic.
 - c. Actuators for valves servicing the fuel oil system and valves located outdoors shall be electric.
 - d. Actuators serving VAV boxes and laboratory areas (supply, exhaust, return) shall have a maximum stroke timing of six seconds from full closed to full open to full closed.
2. Damper actuator mounting shall be outside of the air stream. The actuators shall have external adjustable stops to limit the stroke. The linkage arrangement shall permit normally open or normally closed positions as indicated on the drawings.
3. Modulating damper and control valve actuators and actuators operating valves or dampers which must be sequenced with other valves or dampers shall be equipped with pilot positioners to provide feedback, repeatability and rapid response.
4. When fail-safe positioning is required, actuators shall have spring return.
5. Provide actuator auxiliary (end) switches or slaved potentiometers as required.
6. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two position action.
 - a. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

D. Control Dampers

1. Provide control dampers where indicated on the drawings.
2. Bearings shall be molded synthetic or bronze oilite.
3. Linkage shall be concealed in the frame.
4. Dampers shall be opposed blade in all locations except mixing plenums, where parallel blades shall be positioned to direct air streams into each other, thus facilitating mixing.
5. Furnish single or multiple blade automatic and smoke (UL555S) rated dampers for installation under ductwork paragraph as required.

6. Provide one linkage connection point per eight square feet of section area, equally spaced. Sections shall not exceed 48" x 48". Provide shaft linkage (1/2" minimum bar with crankdown arms attached to blades) on dampers 12 feet or wider. Dampers 12 feet or wider and more than four feet high shall have one line shaft for each four feet of height, or any increment thereof; where size of damper required more than one line shaft, spacing shall be equal.
7. Damper frames shall be 13 gauge galvanized sheet metal with flanges for duct-mounting.
8. Damper blades shall not exceed 6" in width. Blades shall be suitable for duct velocity performance.
9. Damper bearings shall be nylon. Bushings that turn in bearings shall be oil-impregnated, sintered metal.
10. Assembled multiple damper sections shall incorporate mullion supports to prevent failure of sectional assembly.
11. Provide replaceable butyl rubber seals, along top, bottom and sides of frame and along each blade edge. Seals shall provide tight closing and low leakage. 48" x 48" damper section shall have leakage less than 8 cfm/sf at 4" WG differential pressure. Submit leakage and flow characteristic charts for approval. Dampers shall be Honeywell, Inc. #D643 Series, Johnson Controls, Inc., #D-1330 Series, Ruskin SD-50 or Vent Products 5900.

E. Filter Differential Pressure Indicators

1. Diaphragm type with dial and pointer in metal case, adjustable flag, vent valves, black figures on white background, and front recalibration adjustment.
2. Manometer-Type Filter Gauge: Molded plastic with epoxy-coated aluminum scale, logarithmic-curve tube gauge with integral level gauge, graduated to read from 0 to 3 inches w.g. (750 Pa), accurate within 3% of full-scale range.
3. Accessories: Static pressure tips, tubing, gauge connections, and mounting bracket.
4. Integral indicator/transmitters shall conform to the requirements of this paragraph and paragraph 2.1 of this section.

F. Air Flow Measuring Stations

1. Acceptable manufacturers: Air Monitor Corporation, Paragon, Ebtron, or approved equal.
2. All traverse stations must be shown on the sheet metal shop drawings and coordination drawings.
3. Provide for each station a Magnehelic gauge by Dwyer Inc. Gauges shall have dual scales calibrated in both CFM and FPM increments. Gauge face scale shall be matched to duct cross section and CFM involved. Gauge must be calibrated for actual areas. For fan inlets, the shafts and bearing areas must be subtracted if applicable. Mount gauge vertically on ductwork or air handling unit next to or close to the traverse station. Provide two Dwyer A-313 vent valves for each gauge to allow gauges to be removed from connecting tubing. Connect vent valves to traverse stations with copper tubing as shown on detail - Do Not Crimp Tubing.

4. Fan Inlet Air Flow Measuring Stations

- a. At the inlet of each fan where shown on contract documents an airflow traverse probes shall be provided that shall continuously monitor the fan air volumes and system velocity pressure.
- b. Each traverse probe shall be of a dual manifold, cylindrical, type 3003 extruded aluminum configuration, having an anodized finish to eliminate surface pitting and unnecessary air friction except material shall be stainless steel where scheduled. The multiple total pressure manifold shall have sensors located along the stagnation plane of the approaching air flow. The manifold should not have forward projecting sensors into the air stream. The static pressure manifold shall incorporate dual offset static tops on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as + 20° in the approaching air stream.
- c. The airflow traverse probe shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Each airflow measuring probe shall contain multiple total and static pressure sensors placed at equal distances along the probe length. The number of sensors on each probe and the quantity of probes utilized at each installation shall comply with the ASHRAE Standards for duct traversing.
- d. Air flow measuring stations shall be manufactured by Air Monitor Corp.

5. Duct Air Flow Measuring Stations

- a. Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of Fundamentals, as well as in the Industrial Ventilation Handbook.
- b. Traverse stations shall be connected to ductwork with bolts at flanges; stations shall be removable for cleaning. Each probe mounted within the station shall contain multiple total and static pressure sensors placed at equal distances (for rectangular ducts) or at concentric area centers (for circular ducts). The number of sensors provided with each flow station shall comply with the ASHRAE standards for duct traversing. The airflow traverse station shall produce a steady non-pulsating flow signal without need for correction factor or special calibration. The station shall be capable of measuring airflow through the station to within 2% of actual flow.
- c. The probes shall be installed perpendicular to the velocity profile gradient.
- d. Traverse probes or stations that incorporate honeycomb grid or tube type airflow straighteners are not acceptable.
- e. Traverse stations shall be constructed out of the same type material as the duct material.
- f. Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.

- g. Installation Considerations: (1) The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .065" w.c. at 1000 feet per minute, or .23" w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 2% as determined by U.S. – GSA certification tests, and shall contain a minimum of one total pressure sensor per 36 square inches of unit measuring area. (2) The units shall have a self-generated sound rating of less than NC40, and the sound level within the duct shall not be amplified nor shall additional sound be generated. (3) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork. (4) Where control dampers are shown as part of the airflow measuring station, opposed blade precision controlled volume dampers integral to the station and complete with electric actuator and linkage shall be provided. (5) Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.
6. Outside Airflow Measurement System (Louvers/Rainhoods)
- a. Basis of Design - VOLU-flo/OAM (Outside Air Monitor/Controller)
 - b. Provide as indicated an Outside Airflow Measurement System capable of direct measurement of airflow through an outside air inlet and produce dual outputs; one representing the measured airflow, and the other to control the inlet damper.
 - c. The Outside Airflow Measurement System shall contain an integral multi-line liquid crystal display for use during the configuration and calibration processes, and to display two measured processes (volume, velocity, temperature) during normal operation. All configuration, output scaling, calibration, and controller tuning will be performed digitally in the on-board microprocessor via input pushbuttons
 - d. The Outside Airflow Measurement System shall measure inlet airflow with an accuracy of $\pm 5\%$ of reading over a range of 150-600 FPM, 250-1,000 FPM, 150-2,000 FPM, and 500-2,000 FPM and not have its reading affected by the presence of directional or gusting wind. Measured airflow shall be density corrected for ambient temperature variances, and atmospheric pressure due to site altitude.
 - e. The Outside Airflow Measurement System shall interface with the building automation systems (BAS), accepting inputs for fan system start, economizer mode operation, and an external controller setpoint, and provide flow deviation alarm outputs.
 - f. The sensors shall be constructed of materials that resist corrosion due to the presence of salt or chemicals in the air; all non-painted surfaces shall be constructed of stainless steel.
 - g. The electronics enclosure shall be NEMA 1 or NEMA 4. The NEMA 4 enclosure shall have a heater and insulation.

G. Condensate Protection

1. Float Switch

a. Kele model JMP Series

b. Provide either of the following:

- 1) Spring clip for mounting
- 2) L bracket for mounting

2.5 WIRING AND CABLING

A. Wiring and Conduit

1. All wire shall be copper and meet the minimum wire size and insulation class listed below:

Wire Class	Minimum Wire Size	Insulation Class
Power Wiring	12 Gauge	600 Volt
Digital I/O Wiring	14 Gauge	600 Volt
Analog Input Wiring	18 Gauge	300 Volt
Analog Output Wiring	18 Gauge	300 Volt

2. Power and Digital I/O wiring may be run in the same conduit. Analog Input and Analog Output wiring may be run in the same conduit provided they are shielded.
3. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.
4. Where wiring is required to be installed in conduit, conduit shall be as specified in Division 26.
5. Flexible metallic conduit (max. 3 feet) shall be as specified in Division 26.
6. Junction boxes shall be provided at all cable splices, equipment terminations, and transitions from rigid to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location J-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.
7. Exposed wiring shall not be allowed.
8. Install in accordance with requirements of Section 26 10 00 "Raceways."

B. Communications Cabling (Co-axial)

1. Ethernet Platform

a. Coaxial cable shall be RG58 A/U 50 OHM.

b. 30 nodes (controllers) or 600 feet of cable maximum without a repeater.

- C. Communication Cabling (Fiber Optic)
 - 1. Fiber optic cable shall be 62.5/125.
 - 2. Fiber optic cable shall be multi-mode.
- D. Communications Cabling (Twisted Pair)
 - 1. Twisted pair shall be #20 AWG tinned copper conductors; color-coded, plenum rated cable, overall shield and #20 AWG copper drain wire.
 - 2. Twisted pair shall be low capacitance (12.5 pf/ft nominal, 14 pf/ft maximum) and nominal impedance of 100 OHMS and nominal velocity propagation of 78%.
- E. Enclosures
 - 1. All controllers and field interface panels shall be mounted in enclosures suitable for the ambient environment.
 - 2. All outside mounted enclosures shall be NEMA-4 rating.
 - 3. The tubing and wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.
 - 4. All tubing shall be connected to enclosures through conduit. Use bulkhead fittings where appropriate.
 - 5. Control and interface panel assemblies shall be constructed by a UL approved industrial control panel shop and bear a UL approval label on the exterior of each panel.

2.6 SEQUENCES OF OPERATION

- A. Refer to control drawings for required sequences other than those listed below.

PART 3 - EXECUTION

3.1 OEM CONTROLLER INTEGRATION

- A. This section specifies the requirements for interfacing to the original equipment manufacturers (OEM) packaged control systems provided with the equipment specified in the sections listed in Par 1 of this specification.
- B. The BCS Contractor shall be responsible for the development and application of all necessary programming code and the provision of all necessary hardware to allow the OEM packaged control system and the BCS to communicate with one another.
- C. The BCS Contractor shall, at his option, provide communication systems developed by the OEM, if available, for the purposes set forth here-in.
- D. Requirements for all Equipment:
 - 1. Provide for monitoring, alarming, start/stop and setpoint reset control for all equipment as applicable.
 - 2. Communications from equipment shall provide for real time process variable (temperature pressure, etc.) and status information.

- a. All information available at the OEM controller shall be collected by the BCS for display on the BCS graphics.

E. Software Installation:

- 1. The BCS Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

3.2 PROCEDURES

- A. Provide qualified personnel, equipment, apparatus and services for start-up, testing and balancing of mechanical systems, to performance data shown in schedules, as specified, and as required by codes, standards, regulations and authorities having jurisdiction including City, Town or County Inspectors, Owners and Architect. Note that some BCS start-up procedures require the cooperation of the balancing contractor, the equipment manufacturer's representative and the BCS contractor. Ensure that all contractors are present on site during the entire time that these procedures take place. Note that some procedures listed below have a distinct order of precedence, e.g., the testing of the temperature control system shall not occur until major pieces of mechanical equipment have been started up and testing is complete. Ensure that any listed orders of precedence for procedures are followed.
- B. Startup, testing and balancing shall not diminish guarantee requirements.
- C. Notify the Owner's Representative at least two weeks before startup testing and balancing begins.
- D. Before control testing begins a meeting shall be held between the Owner's Representative, the balancing contractor, the BCS contractor, the mechanical and general contractor. The mechanical contractor shall present the Owner's Representative with the completed checklists certifying that equipment startup and testing has been completed. The BCS contractor shall then present his procedures for testing the BCS system to the Owner's Representative for review and approval. Allow one full day for this meeting.
- E. When the control testing has been completed a second meeting will be held between the parties mentioned above. At this time the BCS contractor shall present to the Owner's Representative the completed controls startup checklist. The balancing contractor shall present to the Owner's Representative certificates of calibration for balancing instruments, proposed balancing forms and proposed balancing procedures for review and approval. Allow one full day for this meeting.
- F. It shall be the responsibility of the general contractor to set up these meetings. If, through no fault of the Owner's Representative, the above two meetings do not take place and the BCS and balancing proceeds, the contractor shall be fully responsible to solve any ensuing performance problems.
- G. Do not cover or conceal work before testing and inspection has been approved by the Owner's Representative.
- H. Instruments for testing shall have been calibrated in the installed position within one month prior to testing. Calibration shall be traceable to NIST Standards. Provide certificate of calibration to the Owner's Representative at meeting demonstrating procedures mentioned above.

- I. Leaks, damage and defects discovered during or resulting from startup, testing and balancing shall be repaired or replaced to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.
- J. Report on reporting forms, submitted to the Owner's Representative for approval in advance.
- K. Submit six copies of testing reports to the Owner's Representative for approval.
- L. Install equipment and instruments required for testing, thermo-wells and gauge connections at no additional cost to the Owner.
- M. Qualified representative of equipment manufacturer shall be present at all tests.
- N. Startup and testing procedures outlined below are the minimum effort required for the project. Contractor shall use any additional procedures he feels will be necessary to properly startup and test the job.

3.3 EQUIPMENT STARTUP

- A. Include time to be on site to participate in the startup of the following equipment. The following pieces of equipment will be started in strict accordance with manufacturer's instructions and with manufacturer's representative present:
 - 1. Energy Recovery Ventilator
 - 2. Fans
 - 3. VRF System

3.4 BUILDING CONTROLS SYSTEM

- A. Control System Testing General Requirements
 - 1. Test Control System after all major pieces of equipment have been started up and after all tests have been completed. Note portions of BCS test procedures below, which require cooperation of balancing contractor. Ensure that balancing contractor is present during entire time when these test procedures take place.
 - 2. Where it is said below to confirm or ensure the operation of a particular piece of control equipment, this means to confirm that operation is as called for in the Control Sequence of Operation which are shown on the drawings or listed in the specifications. If operation is not as called for by sequences, make any necessary corrective actions so that controls perform as required on Contract Documents. On completion of testing, fill out, sign and return to the Owner's Representative, the checklist included in this Specification.
 - 3. Perform any additional checkout test required by manufacturer for proper system operation whether or not listed below. If any checkout test below conflicts with a particular manufacturer's recommendation bring matter to the attention of the Owner's Representative immediately.
 - 4. Where it is stated below to verify pneumatic output to a valve, verification shall be done by meters or gauges at the transducer controlling valve and by visual confirmation that the valve travels in the proper direction. Where it is said to visually confirm damper position it means go to location in the field, open access door and note position of damper blades. If access door does not exist, notify the Owner's Representative and General Contractor immediately. EXCEPTION: Do not open air

handler casing when fans are on. Note position of AHU dampers, located within AHU casing, by observing operator position. Readings of output at workstations, laptop computer or position verification by means of feedback potentiometer may be made in addition to but not instead of above measures.

5. Where reference is made below to confirming or ensuring operation of a particular item, it shall mean all items of that type, not a representative sample.
6. Where it is said below to simulate the operation of a particular cycle for the BCS, actual control signal inputs at the time of the test shall be temporarily overridden and test values substituted. For example to simulate an economizer switchover temperature of 70 F outside temperature with the actual outdoor air input is 45 F, temporarily substitute 70 F for 45 F, perform the test then switch back to the actual input when the simulation is complete.

B. Control Start Up Tests

1. With the air handlers supply fan turned off and locked out/tagged out at the disconnect, perform the following tests: (Contractor shall ENSURE that electric power to air handler is OFF).
 - a. Visually inspect all fans interlocked with the supply fan to ensure that they are off.
 - b. Visually inspect all control dampers and ensure that they are in positions that the control sequences call for them to be when the fan is off. Particularly ensure that the outdoor air damper is fully closed.
 - c. Note outputs to all control valves, and ensure that the valves are in position that the control sequence require them to be when the fan is off.
 - d. For DDC system confirmed by checking workstation or laptop that fan status is off.
2. Ensure that all personnel and tools are out of ERV-1 casing, ensure that casing is closed and locked; put any disconnect other than that locked out to the on position. Then have fan started at the locked out disconnect and perform the following procedures.
 - a. For units which are not supposed to start until outdoor air dampers are proven fully open via limit switches visually observe the damper operators and limit switches when the signal is given to start the fan and ensure that the fan does not start until contact with the limit switch is made.
 - b. Ensure that fans interlocked to ERV-1 supply fan run after AHU fan starts. Visually observe each fan.
 - c. Adjust freezestat setpoint upwards until freezestat trips confirm stat has tripped with continuity tester. Ensure that fan stops and dampers and valves go to positions outlined in control sequences. Particularly ensure that outdoor air damper is fully closed (and heating coil valve is fully open). After test, set freezestat setpoint to design, press manual reset button and confirm that fan restarts. (For DDC system ensure that freezestat alarm condition is reported at workstations and printer when freezestat is activated).
 - d. With balancing contractor present, test static pressure low and high limit switches as follows: Connect pneumatic tubing to high or low port of limit switch (depending on whether switch is to trip on low or high pressure)

connect via a tee, the same pneumatic line to manometer. For a high pressure switch connect tubing to manometer port used for measuring positive static pressure. For a low pressure switch connect tubing to port used for measuring negative static pressure. Slowly pressurize tubing and observe manometer. Ensure that switch trips and fan shuts down at pressure called for by control sequence. Confirm that switch has tripped with continuity tester. After test remove test tubing and press manual reset button ensure that fan restarts. (For DDC systems ensure that correct alarm message registers at workstations and line printer when switch trips).

- e. For DDC systems ensure correct status signal registers at workstations and line printer when fan is on.
- f. For DDC system with differential pressure switches across filter bank repeat procedure used to test limit switches and ensure switch trips at correct setpoint. Confirm switch has tripped with continuity tester only (fan should not stop). Confirm dirty filter alarm registers at workstations and printer when switch has tripped.
- g. Confirm that toilet and other exhaust fans start and stop properly via (time clock) (time clock function in DDC systems).
- h. Verify that differential pressure switches across pumps give correct pump status when pumps are on or off.
- i. Confirm alarm setpoints of all alarms listed in sequence of operation. Confirm that adequate differentials exist for all alarms to prevent nuisance tripping. Confirm that all field sensors are properly in place and wired.
- j. Initiate warmup cycle; ensure ALL control components operate as called for in control sequence of operation.
- k. Initiate occupied cycle; ensure ALL control components operate as called for in control sequence of operation.
- l. Initiate unoccupied cycle; ensure ALL control components operate as called for in control sequence of operation.
- m. Test and debug ALL procedures whether or not listed above.
- n. Perform any other tests necessary to verify proper system operation in addition to those listed above.

C. Controls Testing Checklist

1. Fill out the following controls testing checklist for each system on the job. Checklist shall be signed by both representatives of controls vendor and of the general contractor. If a cycle listed below does not apply to a particular system write N.A. (not applicable) under the heading "Date Confirmed". Make as many copies of checklist, and add systems to it as required to list testing of all systems.

System No.			
ATC Cycle	Date Confirmed	ATC Representative Name and Signature	General Contractor Representative Name and Signature

System No.			
ATC Cycle	Date Confirmed	ATC Representative Name and Signature	General Contractor Representative Name and Signature
Fan Differential Pressure Switches			
FCUs for VRF System			
Freezestats			
Filter Diffential Pressure Switches			
Static Pressure Limit Switches			
Smoke Detectors			
Valves Damper Position when Fans are Off			
Fan Interlocks			
Face and Bypass Dampers			
Energy Recovery Ventilator			
Static Pressure Transducer Calibration			
Room Thermostat Calibration			
Alarms			
Warm-up Cycle			
Occupied Cycle			
Unoccupied Cycle			

2. At each constant volume box, use magnehelic gauge to adjust setpoint of box controller to differential pressure corresponding to velocity (airflow) scheduled for box.

3.5 SOFTWARE INSTALLATION

- A. The BCS Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software. This includes any operating system software or other third party software necessary for successful operation of the system.

3.6 DATABASE CONFIGURATION

- A. The BCS Contractor shall provide all labor to configure those portions of the database that are required by the sequence of operation shown on the drawings.

3.7 COLOR GRAPHIC SLIDES

- A. Unless otherwise directed by the Owner, the BCS Contractor shall provide color graphic displays as depicted in the mechanical drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified and allow for setpoint changes as required by the operator.

3.8 REPORTS

- A. The BCS Contractor shall configure a minimum of 6 report types as listed below:
 1. FCU Status Report (One report for each FCU)
 2. ERV-1 Status Report
 3. Energy Consumption Report
 4. Space Temperature Report (One report for each space temperature transmitter)
 5. Specialty Equipment Status Report (One report for each piece of equipment)

3.9 DOCUMENTATION

- A. Software documentation shall include the following as a minimum:
 1. Descriptive point lists
 2. Application program listing
 3. Application programs with comments
 4. Printouts of all reports
 5. Alarm list
 6. Printouts of all graphics
 7. Cross reference locating each I/O and calculated point in the program code

3.10 MOUNTING AND INSTALLATION PRACTICES

- A. Well-mounted sensors shall include thermal conducting compound within the well to insure good heat transfer to the sensor.
- B. Control dampers shall be furnished by this Contractor and installed by Section 23 06 00.
- C. Automatic control valves shall be furnished by this Contractor and installed by Section 23 06 00.
- D. Actuators shall be firmly mounted to give positive movement. Linkage shall be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
- E. Water line mounted sensors shall be removable without shutting down the system in which they are installed (provide valves).
- F. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
- G. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube & static sensing tip. Pipe the low pressure port to the outside of the building.
- H. Conduit, in finished areas, shall be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction.
- I. Conduit, in non-finished areas where possible, shall be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit shall run parallel to or at right angles to the building structure.
- J. Conduit shall be kept a minimum of three (3) inches from hot water, steam, or condensate piping.
- K. Where sensor wires leave the conduit system, they shall be protected by a plastic insert.
- L. Wire or pneumatic tubing shall not be allowed to run across telephone equipment areas.
- M. Control air tubing shall be run concealed wherever possible, properly supported, and installed in a neat and workmanlike manner. Tubing shall not be exposed in occupied areas.
- N. Tubing run in equipment rooms, apparatus rooms, mechanical shafts, and return air plenums shall be installed in conduit. Tubing at air handling units may be installed in metal raceway with connections to devices exposed.
- O. All control tubing or wiring running down exposed walls to controls or control panels shall be run in conduit.
- P. All control tubing or wiring in floor slabs shall run in rigid conduit.
- Q. FR Tubing shall be run in conduit.

3.11 ENCLOSURES

- A. For all input/output devices, which require field interface devices, these devices shall be mounted in a field interface panel (FIP). All other field interface devices shall be mounted at the point of field interface in a separate enclosure suitable for the location. The Contractor shall provide an enclosure, which protects the devices from dust and moisture, and conceals integral wiring and moving parts.

- B. Field Interface Panels shall contain power supplies for sensors, interface relays and contactors, safety circuits, and I/P transducers.
- C. The FIP enclosure shall be of steel construction with baked enamel finish, with a hinged door and keyed lock. The enclosure shall be sized for twenty percent spare mounting space. All locks will be keyed identically.
- D. All wiring to and from the FIP shall be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP shall not be allowed.
- E. All wiring within the FIP shall be run in plastic raceway to provide a neat and workmanlike appearance.
- F. Control and interface panel assemblies shall be constructed by a UL approved industrial control panel shop and bear a UL approval label on the exterior of each panel.
- G. Each control panel shall have a graphic of the system the panel controls with the instrumentation of the equipment and its sequence of operation.
 - 1. The graphics shall be printed on a 2mm polyester sheet then laminated with an 8mm polycarbonate sheet laminate.
 - 2. The graphic shall have 9-year UV protection with a high level of durability and toughness along with water, heat, abrasion and chemical resistance.
 - 3. The adhesive shall provide binding to power-coated paint and other control panel surfaces.
 - 4. The graphic shall be adhered to the front cover of the panel.
 - 5. Vendor – <http://www.labelsandgraphics.com>
 - 6. Model – Super-Tough Polyester

3.12 LOCATION

- A. The location of sensors shall be as indicated schematically on the drawings.
- B. Space humidity and temperature sensors shall be mounted away from machinery generating heat, direct light and diffuser air streams.
- C. Outdoor air sensors shall be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
- D. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.13 IDENTIFICATION

- A. All field devices that are not mounted within panels shall be identified with permanent labels.
- B. All field devices inside panels shall be labeled.
- C. The identification shall match the point description as approved by the Owner's Representative.
- D. Each terminal strip termination shall be tagged with an identification that matches the as-built control drawings.

- E. The outside of each FIP shall be identified with a permanent label matching the identification name shown on the as-built control drawings.
- F. All wiring and tubing shall be labeled at each termination.
- G. Identify all control wires with labeling tape or sleeves at each termination using either words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
- H. Identify all pneumatic tubing with labeling tape or sleeves at each termination using either words, letters, or numbers that can be exactly cross referenced with as-built drawings.
- I. All field enclosures, other than controllers, shall be identified with a permanent nameplate.
- J. Junction box covers shall be marked to indicate that they are a part of the BCS system.

3.14 CLEANUP

- A. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of grease, plaster, or other foreign materials.
- B. At the completion of work at the end of each day, remove from the building, premises, and surrounding streets, etc. all rubbish and debris resulting from the operations and leave all equipment spaces clean and ready for use.

3.15 POWER WIRING

- A. All BCS equipment power shall be powered from the electric panels provided by Division 26.
- B. It is the responsibility of the BCS Contractor to provide 120V power wiring from the breaker provided by Division 26 to the final locations of the BCS equipment.
- C. The power shall be obtained from dedicated circuits 120V panels and clearly labeled by the BCS Contractor. (Refer to the electrical drawings for panel schedules). Any breakers not used by the BCS shall be labeled "spare" by the BCS Contractor.
- D. All power wiring for the BCS equipment shall be done with a dedicated earth ground by means of copper wire media only, originating at the power service source earth ground. This applies to all Level 1 and Level 2 controllers along with work stations and the file server.

3.16 MEDIA CONVERSION

- A. Provide appropriate hubs to convert from one communications media to another.

END OF SECTION

SECTION 261000 - ELECTRICAL

TABLE OF CONTENTS

PART 1 - GENERAL	1
1.1 SUMMARY.....	1
1.2 REFERENCES	3
1.3 QUALITY ASSURANCE	5
1.4 SUBMITTALS	6
1.5 MANUALS AND INSTRUCTIONS.....	7
1.6 RECORD DRAWINGS	8
PART 2 - PRODUCTS	8
2.1 IDENTIFICATION	8
2.2 PANELBOARDS - LIGHTING, POWER AND DISTRIBUTION.....	9
2.3 EXISTING SWITCHBOARDS AND EXISTING PANELBOARDS — LIGHTING, POWER, AND DISTRIBUTION.....	11
2.4 600V INSULATION COPPER WIRE AND CABLE.....	11
2.5 CONDUIT AND RACEWAYS	12
2.6 OUTLET, PULL AND JUNCTION BOXES, AND FITTINGS	13
2.7 WIREWAYS.....	14
2.8 WIRING DEVICES.....	14
2.9 DEVICE PLATES.....	16
2.10 MULTI-OUTLET ASSEMBLIES.....	16
2.11 TIME SWITCH	17
2.12 PHOTOELECTRIC CONTROLLER	17
2.13 DISCONNECT SWITCHES	17
2.14 FUSES.....	18
2.15 ELECTRONIC CHECK METERING SYSTEM.....	18
2.16 HEAT TRACING SYSTEM FOR PIPES.....	19
2.17 SURGE PROTECTION DEVICES (SPD).....	21
2.18 MOTOR CONTROLLERS	26
2.19 OCCUPANCY SENSOR SWITCHES AND LOW VOLTAGE LIGHTING CONTROL SWITCHES.....	26
2.20 LIGHTING	28
2.21 TELECOMMUNICATIONS SYSTEMS PROVISIONS	30
2.22 ACCESS PANELS.....	30
2.23 GROUNDING	30
2.24 SEALS	30
2.25 VIBRATION ISOLATION	31
PART 3 - EXECUTION	34
3.1 REFERENCE.....	34
3.2 SPECIAL RESPONSIBILITIES.....	34
3.3 ELECTRICAL DEMOLITION AND RENOVATION WORK	35
3.4 PREMIUM TIME WORK.....	36
3.5 GROUNDING	37
3.6 SLEEVING AND BUSHINGS	39
3.7 WIRING METHODS	39
3.8 WIRE AND CABLES.....	41
3.9 UNDERGROUND RACEWAYS	42
3.10 UNDERGROUND WIRING.....	44
3.11 PHASING AND COLOR CODING.....	45
3.12 TELECOMMUNICATIONS RACEWAYS	46
3.13 MOUNTING HEIGHTS AND SPECIAL REQUIREMENTS	46
3.14 MOTORS AND CONTROLS	47
3.15 LIGHTING.....	48
3.16 SURGE PROTECTION DEVICES (SPD).....	49
3.17 TESTING AND INSPECTION.....	50
3.18 ACCEPTANCE DEMONSTRATIONS	51

3.19 COOPERATION AND WORK PROGRESS 52

3.20 INSTALLATION 53

3.21 MATERIALS AND WORKMANSHIP 55

3.22 TRAINING 55

3.23 OPERATION INSTRUCTIONS AND MAINTENANCE MANUALS 55

SECTION 261000
ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Documents: The work of this Section is governed by the General Conditions, Supplementary Conditions, Sections in Division 1, Section 20 05 00, and Section 20 05 48 of the Project Manual.
- B. Perform work and provide materials and equipment as shown on Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide complete and fully functional systems' installation.
- C. Give notices, file plans, obtain permits and licenses, pay fees and backcharges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with the Contract Documents.
- D. UL Listing:
 - 1. Furnish UL listed and labeled equipment, devices, and materials. Where a UL listing is not available, submit the test reports of an independent testing engineer indicating that equipment is in conformance with local and state codes. Tests and inspections required for approval shall be performed at no additional cost to the Owner.
- E. In general, the work of this Section shall include, but not be limited to:
 - 1. Grounding Systems.
 - 2. Underground Duct Systems.
 - 3. Metering.
 - 4. Service Conduits and Cables.
 - 5. Panelboards - Lighting, Power, and Distribution.
 - 6. Standby Generator.
 - 7. Raceway Systems.
 - 8. Wireways.
 - 9. Outlets and Pull Boxes.
 - 10. Wires and Cables.
 - 11. Disconnect Switches.
 - 12. Fuses.
 - 13. Enclosed Circuit Breakers.
 - 14. Power and alarm wiring including connections for heating, ventilating, and air conditioning system motors and equipment. All starters and line voltage thermostats will be furnished for installation (wiring, connecting, and mounting) under this Section.
 - 15. Power, control, and alarm wiring, including connections for the Plumbing and Fire Protection Systems Equipment, shall be provided under this Section.
 - 16. Electrical wiring and connections for Owner Furnished Equipment.
 - 17. Devices and Device Plates.
 - 18. Lighting Fixtures.
 - 19. Emergency Battery Units.
 - 20. Astronomic Time Switches.
 - 21. Photo Electric Controls.
 - 22. Relays.
 - 23. Telecommunications Outlets.

24. Protection of new and existing work.
25. Record Drawings and Documentation.
26. Staging.
27. Telecommunication Raceway System.
28. Telecommunication Grounding System.
29. Seismic Supports, Supplementary Steel and Channels.
30. Supervision and approval of Excavation and Backfilling for this Section's work.
31. Operation and Maintenance Instructions and Manuals for this Section's work.
32. Nameplates, Labels, and Tags.
33. Testing and certifications.
34. Fireproofing of Penetrations and Openings.
35. Access panels and doors.
36. Phasing of work, and maintenance of service, to existing and temporarily relocated items, owner equipment or workstations, etc., as required to meet the project schedule, including premium time.
37. Coordination with manufacturers, other trades, General Contractor, and Owner. Include costs associated with adjustments and changes resulting from coordination.
38. Training.
39. Costs associated with core drilling, cutting, and patching using appropriate and trained tradesmen approved by the General Contractor and the Architect.
40. MDO plywood backboards for Telecommunications systems, starters, equipment, etc.
41. Seals.
42. Demolition.
43. Multi-outlet assemblies.
44. Extension of existing security systems.
45. Apply arc flash labels to new distribution equipment.
46. Settings for adjustable trip circuit breakers.
47. New equipment added to existing distribution equipment.
48. Access panels.

F. Related Requirements

1. Section 28 30 00 "Fire Alarm System" for fire alarm system extension.

G. Furnish the following items for installation under other Sections:

1. Emergency generator exhaust silencers and flexible connection(s) for installation under Division 23.
2. Electric solenoid valve on generator fuel line for installation under Divisions 22 and 23.
3. Division 8 - Access Panels.

H. Install the following items furnished under other Sections or by the Owner:

1. Starters (except starters in motor control centers furnished under this Division).
2. Section 23 09 00 provides 120V branch circuit wiring to mechanical control equipment except specific circuits indicated on electrical drawings shall be by this Section. Final connection, testing, and energizing of circuits at branch circuit panel shall be by this Section.

I. Related work specified in other Sections includes, but is not necessarily limited to:

1. Temporary Facilities and Controls: Temporary lighting and power for use during construction.
2. Concrete: Housekeeping pads and inertia pads for vibrating equipment.

3. Structural Steel: Equipment supports.
 4. Metal Fabrications: Structural supports necessary to distribute loading from equipment to roof or floor.
 5. Flashing and Sheet Metal: Flashing of penetrations.
 6. Painting: Except as specified herein.
 7. Metal Flashing and Sheet Metal: Roof and wall penetrations.
 8. Acoustical Ceilings: Removal of existing ceilings for new work under this Section.
 9. All automatic temperature control system components, wiring, and interlock wiring associated with the heating, ventilating, and air conditioning system will be provided under Division 23.
 10. Mounting of mechanical equipment having electrical connections. Refer to work involving mechanical trades.
 11. Starters, variable frequency drives, and control devices for heating, ventilating, and air conditioning equipment, unless otherwise indicated, furnished under Division 23.
 12. Starters and control devices for plumbing equipment, unless otherwise indicated, furnished under Division 22.
 13. Plywood backboards shall be installed by the General Contractor except for those required to mount starters and power equipment.
 14. Excavation and backfill.
 15. Laboratory Equipment - Section 22 10 00 - Plumbing.
- J. Alternates: Refer to pertinent Sections of Division 1 for description of work under this Section affected by Alternates.

1.2 REFERENCES

- A. All materials and work provided shall be in accordance with most recent editions of applicable standards and publications of the following organizations:
1. American National Standards Institute (ANSI).
 - a. C2 – National Electrical Safety Code
 - b. C37.13 – Low Voltage AC Power Circuit Breakers Used in Enclosures
 - c. C37.16 – Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors Preferred Ratings, Related Requirements, and Application Recommendations
 - d. C37.17 – Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers
 - e. C37.90a – Surge Withstand Capability (SWC) Test
 - f. C57.12.28 – Pad-Mounted Equipment - Enclosure Integrity
 - g. C57.12.90 – Test Code, For Distributing Power Transformers
 - h. C62.1 – Surge Arresters for AC Power Circuits
 - i. C62.11 – Metal-Oxide Surge Arresters for AC Power Circuits
 - j. C62.41 – Surge Voltages in Low-Voltage AC Power Circuits
 - k. C62.45 – Low-Voltage AC Power Circuits, Guide on Surge Test
 2. American Society for Testing and Materials (ASTM).
 - a. A79 – Specification for Staybolt Wrought Iron Solid
 - b. A525 – Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - c. A619 – Steel Sheet, Carbon, Cold-Rolled, Drawing Quality
 - d. B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

- e. B33 – Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
 - f. B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
 - g. B465 – Copper-Iron Alloy Plate, Sheet, Strip, and Rolled Bar
 - h. C433 – Quicklime and Hydrated Lime for Hypochlorite Bleach
 - i. D523 – Test Method for Specular Gloss
 - j. D659 – Evaluating Degree of Chalking of Exterior Paints
 - k. D714 – Evaluating Degree of Blistering of Paints
 - l. D1654 – Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
 - m. D2247 – Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
 - n. D2794 – Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
 - o. D3359 – Standard Test Methods for Measuring Adhesion by Tape Test
 - p. D4060 – Abrasion Resistance of Organic Coatings by the Taber Abraser
 - q. E814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops
 - r. G53 – Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials
3. Institute of Electrical and Electronic Engineers.
- a. 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - b. 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - c. 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - d. 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - e. 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
4. National Electric Manufacturers Association (NEMA).
- a. LS1 – Low Voltage Surge Protection Devices
 - b. MG1 – Motors and Generators
 - c. SG3 – Low Voltage Power Circuit Breakers - Power Switching Equipment
 - d. WD1 – General Requirements for Wiring Devices
5. Underwriters Laboratories (UL).
- a. No. 20 – General-Use Snap Switches
 - b. No. 50 – Enclosures for Electrical Equipment
 - c. No. 67 – Panelboards
 - d. No. 486a – Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - e. No. 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
 - f. No. 498 – Attachment Plugs and Receptacles
 - g. No. 924 – Emergency Lighting and Power Equipment
 - h. No. 1008 – Transfer Switch Equipment
 - i. No. 1076 – Proprietary Burglar Alarm Units and Systems
 - j. No. 1283 – Electromagnetic Interference Filters
 - k. No. 1449 – Surge Protection Devices

- l. No. 1479 – Fire Test of Through-Penetration Firestops
 - m. No. 1724 – Tests of Thermal Barrier Systems for Electrical System Components
- 6. National Fire Protection Association (NFPA).
 - a. No. 70 – National Electrical Code
 - b. No. 70E – Standard for Electrical Safety in the Workplace
 - c. No. 90a – Installation of Air Conditioning and Ventilating Systems
 - d. No. 101 – Life Safety Code
 - e. No. 110 – Emergency and Standby Power Systems
- 7. Federal Specifications.
 - a. TT-P-141B – Paint, Varnish, Lacquer, and Related Materials, Methods of Inspection, Sampling and Testing (S/S by FED STD No. 141)
 - b. FED-STD-141 – Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling, and Testing
 - c. W-S-896 – Switch, Toggle (Toggle and Lock), Flush Mounted (General Specification)
 - d. W-C-596 – Connector, Electrical, Power, General Specification For
 - e. W-C-375 – Circuit Breaker, Molded Case, Branch Circuit and Service
 - f. W-P-115 – Panel, Power Distribution
- 8. American Association of State Highway and Transportation Officials (AASHTO).
- 9. Americans with Disabilities Act (ADA).
- 10. American Iron and Steel Institute (AISI).
- 11. Insulated Cable Engineers Association (ICEA).
 - a. S-66-524 – Cross-Linked-Thermosetting-Polyethylene-Insulated Wire & Cable
- 12. Electronic Industry Association / Telecommunications Industry Association (EIA/TIA).
 - a. No. 607 – Commercial Building Grounding / Bonding / Requirement Standard

1.3 QUALITY ASSURANCE

- A. Qualifications: Use adequate numbers of skilled, licensed workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
 - 1. The Installer (Firm and Employees) shall be experienced in the operations they are engaged to perform and have at least five years of continuous recent experience on similar projects. The Installer shall hold recent, up-to-date licenses, certifications, and training certificates in the area in which the project is located and for the equipment to be installed.
 - 2. Provide a full time on-site foreman who personally has been certified as described above. Submit all documentation under this Section.

3. Each Foreman and Installer working on this project shall be trained by the Manufacturer whose equipment is being provided on the project. The training shall consist of a minimum of proper installation techniques of their specific equipment in order to have a complete operating system meeting or exceeding the requirements as specified herein. Each Foreman and Installer working on this project shall have documentation from the manufacturer indicating that they have been adequately trained prior to the start of the project. Only Foremen and Installers who have been properly trained and documented by the manufacturer whose equipment is being provided on this project shall be allowed to install same.

1.4 SUBMITTALS

- A. Comply with the pertinent provision of Sections in Division 1.
- B. Qualifications: Submit qualifications as specified in this Section under Quality Assurance.
- C. Organization of Shop Drawings: Submit shop drawings and product data submittals in bound packages organized and titled to match the Articles of Part 2 as specified in this Section.
- D. Product Data: Submit catalog data sheets or other published materials showing appearances, electrical ratings characteristics and connection requirements, seismic certifications, performance characteristics, dimensions, weights, installation methods, and space requirements of electrical equipment and their accessories, as indicated in the submittal schedule.
- E. Shop Drawings: Submit shop drawings indicating physical size and arrangement, (plans and elevations) construction details, provisions for conduits, access requirements for installation and maintenance, seismic certifications, finishes, and materials used in fabrication.
- F. Prior to installation of electrical equipment provide a detailed layout of electrical equipment, including code required clearances for:
 1. Main Electric Rooms.
 2. Electric Closets.
 3. Mechanical Rooms.
 4. Electric Panels.
- G. For equipment requiring utility company approval, provide a letter from local electrical utility company serving this building stating that the proposed equipment may be acceptable subject to final utility approval of shop drawings. Include Manufacturer's signed statement indicating approval will be received from local electrical utility company serving this building even if other equipment must be substituted, and will be accomplished within the time frame as indicated in the specifications.
- H. Equipment start-up and commissioning reports.
- I. Submittal Schedule: Prepare and submit product data shop drawings, Operations and Maintenance (O&M) manuals and perform training as indicated on the following schedule:

PRODUCTS	Product Data	Shop Dwgs	O&M Man.	Spare Parts List	Demonstration / Training
UNDERGROUND SYSTEM	X	X			
CONDUIT AND RACEWAYS	X				
OUTLET, PULL AND JUNCTION BOXES, AND FITTINGS	X				
WIREWAYS	X				
WIRE AND CABLE	X				
MOTOR CONTROLLERS	X	X	X		
PANELBOARDS - LIGHTING, POWER, AND DISTRIBUTION	X	X	X		
EQUIPMENT ADDED TO EXISTING PANELBOARDS - LIGHTING, POWER, AND DISTRIBUTION	X	X	X		
DISCONNECT SWITCHES	X		X		
FUSES	X			X	
REMOTE CONTROL SWITCHES	X				
AUTOMATIC CONTACTORS	X		X	X	
OCCUPANCY SENSOR AND LOW VOLTAGE LIGHTING CONTROL SWITCHES	X				
WIRING DEVICES	X				
DEVICE PLATES	X				
MULTI-OUTLET ASSEMBLIES	X				
TIME SWITCH - ASTRONOMIC DIAL	X		X		
PHOTOELECTRIC CONTROLS	X		X		
LIGHTING	X	X	X		
EMERGENCY BATTERY UNITS	X		X	X	X
GENERATOR (NATURAL GAS)	X	X	X	X	X
ELECTRIC ROOM/CLOSET LAYOUTS		X			X
TELECOMMUNICATIONS SYSTEMS PROVISIONS		X			
SURGE PROTECTION DEVICES	X		X	X	X
GROUNDING	X	X			
VIBRATION ISOLATION	X	X			
ENCLOSED CIRCUIT BREAKERS	X	X	X		
SEALS	X		X		

1.5 MANUALS AND INSTRUCTIONS

- A. Operation and Maintenance Manuals: Prepare manuals in compliance with the pertinent requirements of the Division 1 Section regarding Contract Close-Out Issues, Section 20 05 00 - Basic Facility Services Subgroup Requirements, and the additional requirements of this Section. In addition to the requirements of other Sections, each manual shall include:
1. Product data cut sheets and approved shop drawings for equipment and materials as specified in this Section.
 2. Lubrication and periodic maintenance instruction.
 3. Equipment start-up and commissioning reports.
- B. Instruction Seminar: Perform systems instruction seminar and walk-through with the Owner's Representatives after preparation and review of the Operations and Maintenance Manuals.

- C. Schedule Manufacturer's factory representatives to perform equipment start-ups and instruction seminars as directed by Owner and as specified.

1.6 RECORD DRAWINGS

- A. Provide a complete set of electric and hard copy as-built drawings. Drawings shall be full-size AutoCAD drawings. Title blocks shall include the project name and company name and information of the Electrical Installer. Engineering consultant's company name and information shall not be included. Five (5) sets of complete as-built drawings shall be bound and provided.
- B. All equipment devices, fixtures, wiring systems, feeders, communications systems trunks conduits, etc. shall indicate the actual installed locations.
- C. Provide additional information as follows:
 - 1. All circuit numbers as installed.
 - 2. All equipment designations as installed.
 - 3. Indicate all new and existing devices, multi-outlet assemblies, lighting fixtures, controls, distribution equipment, fire alarm equipment and devices, communications system outlets, disconnect switches and motor controllers.
 - 4. Indicate all diagrams and details from electrical drawings updated for actual installation.
 - 5. Indicate locations and routing of all feeder conduits, telecommunications trunk conduits, power and lighting conduits 2-inch trade size or larger, conduits installed across the roof, underground conduits and fire alarm wiring between control equipment.
 - 6. Indicate locations of all override/bypass relays and all other control relays.
 - 7. Indicate all pullboxes and junction boxes containing feeders and/or more than (3) branch circuits.
 - 8. Indicate pullboxes and junction boxes with any dimension 18 inches or greater and all wireways that are located in electrical, mechanical and telecommunications rooms and closets.
 - 9. Indicate all relay packs for occupancy sensors and photo sensors.
 - 10. Replace lighting fixture schedule with final approved bill of material for installed lighting fixtures.
 - 11. Update circuit number in schedules and diagrams for actual as installed.
 - 12. Indicate all locations of expansion joints and expansion fittings.
 - 13. Indicate all locations of seismic restraints.

PART 2 - PRODUCTS

2.1 IDENTIFICATION

- A. All equipment and designated devices shall be properly identified by means of permanent, clear, and concise nameplates, tags, signs, or directories mechanically fastened or engraved on the item to be identified. Embossed adhesive labels are only acceptable for 125 volt receptacles, lighting control switches, toggle switch motor disconnects and override relays.
- B. Provide tags identifying each individual cable, wire, or group of wires comprising a circuit or feeder in all panelboards, switchboards, motor control centers, pull boxes, troughs, and terminal boxes through which such wires run and at the equipment at which they terminate. Tags shall be flameproof linen fiber or pressure sensitive type unless otherwise indicated. The circuit or feeder designation and tags shall be as approved by the Architect.

- C. Provide mechanically fastened three ply black bake-lite nameplates with 1/4" high engraved white letters on the following equipment. Wording of the nameplates shall be in conformance with the respective schedules and notes on the Drawings.
 - 1. Lighting, Power and Distribution Panelboards, Fire Alarm, and Telephone Terminal cabinets: Nameplates shall be provided on the exterior of each panel and terminal cabinet door identifying same. Nameplates shall read as indicated on the Drawings, with the source name, source location, the voltage system and shall be mounted on the exterior of the panel and terminal cabinet doors 1/3 of the way down from the top of same.
 - 2. Automatic Transfer Switches: Nameplates shall include as follows:
 - a. Normal power system feeder equipment and location of that equipment.
 - b. List generator and locations for the emergency feeder.
 - c. Equipment feed and location of that equipment.
 - 3. Nameplates shall be provided for each remote operating station, disconnect switch, starter, pilot light, and control device identifying the units controlled or protected, the source, the source location and the voltage system.
 - 4. All distribution equipment shall have an identification nameplate designating the short circuit rating.
- D. Provide typewritten directories under transparent plastic on inside face of the doors on the panelboards.
- E. Provide a nameplate at each switchboard, panelboard, and terminal cabinet indicating the upstream equipment feeding this equipment and the location that upstream equipment.
- F. Color-Code junction boxes, raceway, and conductors as indicated in this specification.
- G. Provide a placard at all service entrance equipment (main building switch) and generator identifying the location of all the other service entrance equipment and generators. Provide white letters on red background. Minimum letter height 1/4".
- H. Labels and installation shall meet the requirements of ANSI/TIA/EIA 606 and 607.
- I. Provide additional warning signs, plaques, or directories as required by code, local authority, or as specified or indicated on the Drawings.
- J. Identification materials shall be as manufactured by Seton Nameplate Company or approved equal by Dennison Manufacturing Company or Markem Company.

2.2 PANELBOARDS - LIGHTING, POWER AND DISTRIBUTION

- A. Panelboards shall be as manufactured by Square D, ABB, Eaton, or Siemens.
- B. Panelboards shall be of the dead-front type suitable for 120/208V, three phase, four-wire operation and shall have a short circuit current rating equal to or greater than the integrated equipment rating as scheduled on the contract Drawings.
- C. Panelboard cabinets shall be fabricated from code gauge galvanized sheet steel and furnished with either flush or surface trim. Trims shall be finished in gray enamel paint over a rust-inhibiting prime coat. A turned edge shall be provided around the front of the

box for rigidity and attachment of the front. Trims shall be fitted with hinged doors having combination lock and latch, with all locks keyed alike. (Power and lighting panels shall have door in door type trim with heavy duty, continuous, section vertical hinging to box section for access to wiring gutters in addition to trim door. The inner door shall allow keyed access to CBs and the second door shall allow bolt access to tub interior wiring gutters). A directory holder with a clear plastic or glass plate and metal frame shall be mounted on the inside of each door. A neatly typed directory properly identifying each circuit shall be provided in the holder.

- D. Interiors shall have copper or tin plated aluminum bus bars with mains arranged for a grounded solid-neutral system with lugs only in the mains or main breakers as indicated. Panelboard shall be suitable for use with 75°C conductor ampacities.
- E. For panelboards on the secondary side of a transformer or fed via a feeder tap, provide a barrier on the load side of the panel, placed such that no energized, uninsulated, ungrounded busbar or terminal is exposed.
- F. Neutral bus shall be insulated from the panel enclosure, except provide bonded neutral only for service entrance equipment. Panelboards shall have a separate equipment ground bus and terminal strip.
- G. Circuit breakers shall be molded case, thermal magnetic type with bolted connections to the bus and shall be single, double, and three-pole circuit breakers with interrupting ratings indicated on the Drawings. The design of the structure shall be such that the units may be removed without disturbing adjacent sections, bus structure, or insulation. Circuit breakers shall be labeled for use with 75°C conductor ampacities. Circuit breakers used for switching shall be type "SWD". Circuit breakers for HVAC equipment and any other equipment with multiple motors shall be type "HACR".
- H. Automatic tripping shall be indicated by handle automatically assuming a position between the manual "OFF" and "ON" positions. The individual breakers shall be calibrated and sealed to eliminate tampering or unauthorized changes in calibration. Breakers shall be interchangeable and capable of being operated in any position. Two and three-pole breakers shall be common trip type so that an overload on one pole will trip all poles simultaneously. No handlebar ties will be allowed on multi-pole circuit breakers to accomplish either manual or automatic tripping. All circuit breakers with trip sizes larger than 225 Ampere rating shall have interchangeable trips.
- I. All circuit breakers rated 125 Ampere to 600 Ampere feeding motors shall have adjustable magnetic trip units with a range 500% to 1000% (10 percent tolerance) of trip unit rating.
- J. Series rating of equipment or overcurrent protection devices shall not be permitted. Provide a fully rated system, where each equipment or overcurrent protected device has an individual interrupting rating at nominal voltage that exceeds the short circuit at the line terminals.
- K. Circuit breaker lockable devices suitable to lock breakers in the open or closed position shall be provided for the following:
 - 1. Minimum of two pad lockable units per panelboard.
 - 2. Fire alarm circuits.
 - 3. Emergency lighting circuits.
 - 4. Night/security lighting circuits.
 - 5. Security power circuits.

- L. Provide seal wire on fire alarm, emergency lighting, and security system branch circuits locking unit in the closed position.
- M. Where panelboards are located at service entrance and/or indicated as service entrance equipment, they shall be UL listed as service entrance equipment.
- N. Provide permanent pole numbers that shall be located adjacent to respective pole (active, spare and space) with odd numbers on the left side and even on the right side.

2.3 EXISTING SWITCHBOARDS AND EXISTING PANELBOARDS — LIGHTING, POWER, AND DISTRIBUTION

- A. The existing panelboards shall be suitable for 208/120V, 3 phase, 4 wire operation as previously installed.
- B. New circuit breakers added to existing switchboards and panelboards shall be the same frame size and ampere interrupting capacity as the existing panelboards, and circuit breakers of similar ampacity. Circuit breakers used for switching duty shall be Type "SWD". Circuit breakers used for HVAC equipment and other multi-motor equipment shall be Type "HACR".
- C. No series rated devices may be added to existing equipment, unless existing equipment is already series rated and the new circuit breakers are of same manufacturer and model as the existing equipment.
- D. Provide all bussing extensions and bus connection kits for proper installation of new circuit breakers to existing switchboards and distribution panelboards.
- E. Provide new nameplates to designate equipment added to existing switchboards and distribution panelboards. Style to match existing, unless if no existing nameplates provide as per Identification Section of specifications.
- F. Update directories in existing branch circuit panelboards as per project revisions.

2.4 600V INSULATION COPPER WIRE AND CABLE

- A. Provide annealed copper wire and cable with insulation rated for 600V and 90°C of sizes specified and as manufactured by General Cable, Encore Wire, Southwire, or approved equal.
- B. Wire and cable shall have copper conductors. Copper wires shall be soft drawn, annealed with 98% conductivity and insulated for 600V. All conductors #10 AWG and smaller shall be solid. All conductors larger than #10 AWG shall be stranded. Conductors shall be color coded as specified under Execution.
- C. Wire sizes #14 through #6 AWG shall be type THHN/THWN-2; wire size #4 and larger shall be type XHHW-2 or THHN/THWN-2. Type SF-2 shall be used for connections to and wiring installed in lighting fixtures.
- D. Service entrance conductors, and conductors installed underground in raceways other than sleeves, shall be dual rated type RHW-2/USE-2 with XLPE insulation. Conductors, other than service entrance, installed underground in raceways may also be type XHHW-2.
- E. Fire-protective signaling wiring shall be in accordance with the Electrical Code, Article 760, Fire Prevention Systems for Building Fire Alarm Systems, and as indicated. All wires for the local fire alarm system shall be color-coded and the size and type as

recommended by the manufacturer of the fire alarm system. Initiating circuits in multiplexed or addressable systems shall be shielded.

- F. All circuit phases shall be color-coded as indicated herein, at terminations, splices, and pull boxes by colored insulation or electrical plastic vinyl tape such as 3M Scotch Brand No. 35 color-coding tape or equal.
- G. Wire connectors for copper wire rated at 600V and lower (105°C rated and below), sizes #18 through #6 AWG, solid or stranded, shall be screw-on type pressure connectors (of the "SCOTCHLOK" type) incorporating a non-restricted, zinc coated spring and insulated with a vinyl jacket having a flexible skirt. Connectors for larger size wires shall be as manufactured by Thomas & Betts Co. or approved equal. Connectors shall be listed for use at 600V.
- H. Wire connectors used above grade in damp wet or exterior locations shall be filled with a waterproofing material and listed for the use.
- I. Flexible metal clad (MC) cable shall have the required number of phase conductors, neutral conductors, and full size insulated (green) ground conductor. Conductors shall be #12 AWG minimum, rated 90°C used at 60°C ampacities. Armor shall be galvanized steel or aluminum. Fittings for MC cables shall be steel.
- J. All cables in air plenum spaces that are not installed within a protective conduit system shall be approved for air plenum installation. This includes signal and communication cables.

2.5 CONDUIT AND RACEWAYS

- A. Galvanized rigid steel conduit (RSC) shall be zinc-coated steel conforming to industry standards and specifications as manufactured by Allied Tube & Conduit Corp., Republic Steel Corp., Wheatland Tube Co., or approved equal.
- B. Intermediate Metal Conduit (IMC) shall be zinc-coated steel conforming to industry standards and specifications as manufactured by Allied Tube & Conduit Corp., Wheatland Tube Co., or approved equal.
- C. Electrical Metallic Tubing (EMT) shall be zinc coated steel conforming to industry standards and specifications as manufactured by Allied Tube & Conduit Corp., Republic Steel Corp., and Wheatland Tube Co.
- D. Non-metallic conduit shall be Schedule 40 100% virgin polyvinyl chloride (PVC), 90°C UL-rated, and by Prime Conduit or approved equal.
 - 1. Conduit, fittings, and solvent cement shall be by single approved manufacturer.
 - 2. Conduit shall meet NEMA requirements and shall be UL-listed as required by Article 352 of NEC.
 - 3. Material shall have a minimum tensile strength of 7,000 psi at 73.4°F, a minimum flexural strength of 11,000 psi, and a minimum compressive strength of 8,600 psi.
- E. Flexible metallic conduit shall be full thickness wall galvanized, spiral wrapped metallic conduit (Greenfield) or liquid-tight flexible metallic conduit as specified for specific equipment. Fittings for flexible metal conduit shall be steel, except those for liquid-tight flexible metal conduit shall be die-cast and watertight.
- F. Conduit expansion fittings shall be threaded hot-dipped galvanized malleable iron with internal bonding assembly by O.Z./Gedney or approved equal.

- G. Conduit fire seal fittings shall have heat-activated intumescent material for fire rating equal to or higher than that of floor or wall by O.Z./Gedney or approved equal.
- H. Provide water-tight gland sealing assemblies with pressure bushings as required for penetrations.
- I. Fittings for rigid steel and intermediate metal conduit shall be threaded malleable iron. Hubs shall be flame resistant insulated throat and be self-locking weatherproof type.
- J. Fittings for electrical metallic tubing shall be compression or set screw type. Compression fittings shall be watertight with positive ground. Connectors, couplings, and setscrews shall be galvanized steel with wall thickness equal to EMT. Setscrew connectors for tubing sizes larger than 2" shall have minimum of four screws for couplings and two setscrews for connectors or fittings. Provide insulating inserts where required. Die-cast fittings shall not be accepted.

2.6 OUTLET, PULL AND JUNCTION BOXES, AND FITTINGS

- A. Outlet, pull and junction boxes for general use in dry locations shall be NEMA 1 enclosures. Outlet, pull and junction boxes in wet locations, exterior or flush mounted in concrete shall be cast metal type or NEMA 4X stainless steel type.
- B. Provide as a part of the raceway system all outlet, pull, back and junction boxes and supports required for the proper installation of all components of the Electrical System.
- C. Outlet boxes shall, in general, be as follows:
 - 1. Outlet boxes shall be 4" square minimum with plaster ring extension size for devices specified.
 - 2. Exposed, surface, and pendant mounted outlet boxes, or outlet boxes installed in normally wet locations, shall be of the cast metal type with threaded hubs.
 - 3. Recessed outlet boxes for dry locations shall be of the pressed sheet steel, zinc coated type.
 - 4. Surface mounted boxes on existing concrete block walls shall be Wiremold (for dry locations only) or cast boxes without knock-outs, suitable for painting. Device plates shall not overlap boxes. Surface boxes for fire alarm devices shall be red with sufficient size so that devices do not overlap boxes.
 - 5. Outlet boxes shall not be less than 1-1/2" deep unless shallower boxes, larger sizes shall be as indicated are required by structural conditions and are specially approved by the Architect. Outlet boxes for telecommunications and security system work shall be as indicated.
 - 6. Ceiling and bracket outlet boxes shall not be less than 4" octagonal except that smaller boxes may be used where required by the particular fixture to be installed. Flush or recessed fixtures shall be provided with separate outlet boxes where required by the fixture terminal temperature requirements.
- D. Pull and junction boxes shall be as follows:
 - 1. Pull and junction boxes less than 6" x 6" shall be as specified for outlet boxes.

2. Pull and junction boxes shall be constructed of code gauge galvanized sheet metal of not less than the minimum size required by the Electrical Code or other applicable Specification "Standards" and shall be furnished with screw fastened covers. Boxes exceeding 48" in any direction shall be properly reinforced with angle iron stiffeners.
 3. Pull and junction boxes to be installed in normally wet location areas shall be of the cast type or NEMA 4X stainless steel. Provide with threaded hub and gasketed cover plate.
- E. Fittings shall, in general, be as follows:
1. Adequate expansion/compression fittings shall be used where crossing building expansion joints. Expansion fitting shall be multidirectional and have grounding jumpers, and shall be manufactured by O-Z Gedney, Crouse-Hinds, or approved equal.
 2. Raceways shall have expansion fittings installed as recommended by the manufacturer. Provide a minimum of one expansion fitting per 100' (30.5m) or fraction thereof for non-metallic raceways.

2.7 WIREWAYS

- A. Wireways shall be of sheet steel with screw covers, which shall be galvanized or painted to protect against corrosion and shall conform to industry standards and specifications. All necessary bends, couplings, connectors, etc. shall be provided.
- B. Wireways shall be suitable for lay in conductors with connector covers permanently attached so that removal is not necessary to utilize lay in feature.
- C. Interior parts shall be smooth and free of sharp edges and burrs.
- D. Wireways shall be sized for adequate wire bending radius as required by code.
- E. Wireways shall be as manufactured by Square D or approved equal.

2.8 WIRING DEVICES

- A. Wiring devices shall be made by single manufacturer; Hubbell Inc. Leviton, Pass and Seymour/Legrand, Cooper Wiring Devices, or approved equal.
- B. Bodies shall be of thermoplastic compound, with faces of nylon supported by mounting yoke having plaster ears and shall be NEMA WD-1 heavy duty "Commercial Specification Grade" (Unless otherwise indicated on detail drawings / Symbol List). All devices shall be the grounding type and shall be connected to metal mounting yoke. A green terminal screw shall be provided for the ground wire on all receptacles.
- C. Wiring devices color shall be as selected by Architect.
- D. All receptacles unless specifically indicated otherwise shall be as follows:
 1. Receptacles shall be side wired with two screws per terminal. Provide receptacles tested to UL 498, NEMA WD-1 heavy duty and Federal spec WC596 where applicable. Receptacles on individual branch circuits shall match the ampacity of the circuit.

2. All receptacles - Duplex 20 ampere, 125 volts, 1 phase, 3 wire, U-Slot grounded type Hubbell 5362 or equal.

E. Ground Fault Circuit Interrupter Receptacles

1. Ground fault interrupter type 'GFCI'- Duplex 20 ampere, 125 volts, 1 phase, 3 wire U-Slot grounded type. Provide self-monitoring or auto-monitoring GFCI receptacles with the ability to monitor ground fault functionality automatically every 30 seconds. Ground fault test function shall sense a ground fault and interrupt the circuit in an actual ground fault condition. (All "GFCI" devices shall meet the latest version of UL 943 and in keeping with this standard have a visual end of life indication). Receptacles shall be Hubbell GFRST20 or equal. Provide Tamper Proof type where required by code.
2. Provide reverse line-load misfire function to deny power to the face of the receptacle if the line is cable wired to the load terminal of the receptacle.
3. Weatherproof – 20 ampere, 125 volts, 1 phase, 3 wire, U-Slot grounded type with "in use" weatherproof cover and gasket, NRTL listed for wet locations use Hubbell WP8M, and ground fault circuit interrupter Hubbell GFWRST20W or equal.
4. Provide ground fault circuit interruptible receptacles as required by code and as listed below:
 - a. Bathrooms
 - b. Kitchens
 - c. Rooftops
 - d. Outdoors
 - e. Sink – where installed within 6 feet of the edge
 - f. Indoor damp or wet locations
 - g. Locker rooms with showering facilities
 - h. Laundry rooms areas
 - i. Bathtubs and shower stalls - where receptacle is installed within 6 feet of the outside edge of shower stall or bathtub.
 - j. Areas with sink and permanent provisions for food prep, beverage prep or cooking.
 - k. Sinks where receptacles or cord and plug connected fixtures or stationary appliance are installed within 6 feet from top inside edge of the bowl sink.
 - l. Electrical room and closets.

F. Controlled Receptacles for Energy Management

1. All 125 volt, 20 amp receptacles that are controlled by an automatic control device, or that incorporate control features that remove power from the outlet for the purpose of energy management or building automation shall be marked as per the NEC. The symbol shall be located on the receptacle so visible after installation.

G. Special receptacles as specified on the Drawings shall have suitable caps and plates or covers.

H. Toggle Switches:

1. Toggle switches shall be side wired and shall be of the totally enclosed, flush tumbler type of suitable capacity for the intended load and shall be "Specification

Grade". Provide listed switches tested to UL 20 and Federal spec WS896E where applicable.

2. Toggle switch bodies shall be NEMA WD-1 heavy-duty thermoplastic compound, quiet indicating type with screw type terminals. Provide green grounding terminal screw.
3. General lighting switches shall be 1 pole, 2 pole, 3 way 4 way or Keyed with or without pilot light and be 20 ampere, 120/277 volts AC. Hubbell 1221- Series & Hubbell HBL1221RKL Locking Type or equal.

I. Dimmers:

1. Dimmer switches shall be Lutron Nova Series (Slide switch), or approved equal, of wattage rating as required.

2.9 DEVICE PLATES

- A. Wiring device plates shall be of the same manufacturer as the wiring devices.
- B. Device plates of the one-piece type shall be provided for all outlets to suit the devices installed.
- C. Plates on unfinished walls or fittings shall be of zinc-coated sheet metal with countersunk heads of the same finish as the plate.
- D. Provide 0.040" brushed stainless steel device plates.
- E. Indicate panel and circuit number on wiring device plate. See "Identification" for label requirement.
- F. Provide oversized device plate as required to hide wall opening. Adjacent plates shall be similar in size.
- G. Outdoor devices shall have wet location listing for "in-use" weatherproof covers as manufactured by Hubbell Inc. or equal.
- H. Receptacle device plates for circuits other than 120 V, 2-wire, shall be engraved with ¼" letters on red background, indicating voltage characteristics and circuit number of outlets.

2.10 MULTI-OUTLET ASSEMBLIES

- A. Multi-outlet assemblies shall be as manufactured by Hubbell, the Wiremold Company, or approved equal.
- B. Fixed field wired steel multi-outlet assemblies [Wiremold 3000, 4000, 6000] shall consist of surface metal raceway and receptacles, which shall be spaced as, indicated on Drawings. Receptacles shall meet specified requirements. Ground conductor shall connect receptacle ground terminals and shall be secured to building equipment grounding system. Where more than one circuit serves several similar receptacles in common raceway, do not connect adjacent receptacles to same circuit unless otherwise indicated. Assembly to be furnished by manufacturer with proper barriers where required by Code.
- C. Provide snap-on blank covers, snap-on receptacle covers, or both, by the raceway manufacturer, with no open cracks. Where industry standard device plates are installed on raceway, snap-on blank covers shall be accurately cut to avoid open cracks. Finish

on device plates, raceways, and covers shall be factory standard finish as selected by the Architect.

- D. Provide suitable fittings, elbows, clips, mounting straps, connection blocks, insulators, and associated hardware as required. Provide ½" or larger rigid concealed conduit to connect any raceway sections that are not continuous.
- E. Provide with standard finishes as selected by Architect, unless otherwise indicated.
- F. Surface Aluminum Raceways: Anodized Aluminum with snap-on covers complying with UL 5. Hubbell (HBLALU3800 single channel) (HBLALU4800 dual channel) (HBLALU5000 dual channel) (HBLALU7620 triple channel). Each wiring channel shall be Capable of housing a standard 20 to 30 amp NEMA device flush within the raceway. Multiple channels shall be used to provide division between circuit voltage and low voltage. Aluminum raceways shall be available as factory prewired and assembled in order to provide highest quality control and appearance.

2.11 TIME SWITCH

- A. Time Switches shall be a minimum of 2 channels digital astronomic time switch manufactured by Tork, Intermatic, Paragon, or approved equal.
- B. Time Switch contacts shall be capable of switching 30 amperes per pole continuously at 277V and shall be SPDT (DPST, 3 PST, DPDT, and SPDT as required). Terminals shall be of the pressure type 75 degree C, capable of receiving #10 AWG wire.
- C. Controller shall program in AM/PM (12 hour) or Military (24 - hour) formats. Controller shall program in one-minute resolution. Display shall be of LCD type.
- D. Controller shall be capable of 99 setpoints; separate scheduling for each day of the week. Controller shall have 365-day holiday capabilities with 24 single dates. Controller shall have Daylight Saving or Standard time. Controller shall have automatic Leap Year correction. Controller shall have Permanent Schedule Retention.
- E. Controller shall have 100 hours backup for real time with built in battery backup.
- F. In addition to Time Switches, provide interconnecting control wiring and Automatic Contactor where multiple branch circuits are controlled. Controller shall be capable of manual override ON or OFF to the next scheduled event using one button. Unit shall have NEMA Type 3 Indoor/ Outdoor enclosure.

2.12 PHOTOELECTRIC CONTROLLER

- A. Photoelectric controller shall be manufactured by Tork, Intermatic, Paragon, or approved equal.
- B. Photoelectric controls shall be SPST, 10amp at 120V, weatherproof, and tamperproof type with cast aluminum housing. Operating levels shall be adjustable from 2 to 50fc through the use of an adjustable sliding bar. Controls shall have a built in time delay to prevent false switching. Model shall be Tork, 2100 Series.
- C. In addition to photoelectric controllers, provide interconnecting control wiring and an Automatic Contactor where multiple branch circuits are controlled.

2.13 DISCONNECT SWITCHES

- A. Disconnect switches shall be manufactured by ABB, Square D, Eaton, or Siemens.

- B. Disconnect switches shall be of the fusible or non-fusible type as indicated and equipped with an external lever or handle for manual operation. Each unit shall be enclosed in a code-gauge, sheet steel cabinet with hinged door and catches and suitable for surface mounting as indicated on the Drawings. Switches shall be horsepower rated, heavy-duty type in NEMA I enclosures of the size indicated on the Drawings or as required. NEMA Type 3R switches shall be provided where exposed to weather. Provide disconnect switches that are rated for use with E rated motors. Disconnect switches shall include arc containing shields.
- C. Provide switches of the proper voltage rating and number of poles required for the use (1, 2, 3, 6 pole, etc.) Neutral conductors, where present, shall be unswitched. Fusible type disconnect switches shall have rejection type fuse clips. Disconnect switches shall have provisions to be pad locked in the open position.
- D. A disconnect switch shall be provided for all power equipment as required by the Electrical Code, whether or not indicated on the Drawings.
- E. For disconnects on the secondary side of a transformer provide a barrier on the load side of the disconnect, placed such that no energized, uninsulated, ungrounded busbar or terminal is exposed.

2.14 FUSES

- A. All secondary system fuses, rated at 600V or less, shall be manufactured by Bussman, Chase-Shawmut, or Littlefuse.
- B. Provide all fuses of the Ampere rating equal to the feeder rating for general-purpose circuits and as recommended by the manufacturer for equipment containing motors. Fuses for general-purpose circuits shall be current limiting, one time, rejection type, UL Class R, Type RK1 or RK5 with a short circuit rating of 200,000 amperes RMS. Fuses for motor circuits shall be dual element fuses, current limiting and time delay, cartridge type UL Class RK-5, with short circuit interrupting capacity of 200,000 amperes RMS.
- C. Upon completion of construction and before final acceptance of the building, furnish to the Owner one complete set of three fuses for each type installed in the building under this Contract. The spare fuses shall be turned over to an authorized representative of the Owner, designated by the Architect, upon completion of the Construction Program.

2.15 ELECTRONIC CHECK METERING SYSTEM

- A. Provide Kilowatt hour/demand meters to allow individual metering of circuits. Metering information shall be displayed locally and shall be transmitted to a central location to provide individual outputs and trending on a Windows based host computer. Acceptable manufacturers shall be E-Mon Corp. and National Meter Industries.
- B. Meter shall use split core current transformers (solid core shall not be utilized). Core and coil shall be wrapped in tape or dipped in plastic. The core shall be tightly held together and clearly marked with rating and accuracy. Meter shall directly connect to the service voltage of 120V or 208V.
- C. Meter shall be enclosed in a heavy-duty steel enclosure. The meter enclosure shall provide a method of locking to prevent unauthorized access. Meter shall be fully electronic with a digital LCD display for kilowatt-hour and demand readings. Meter shall provide rate of consumption indication and also a segment test button to assure the integrity of the display.

- D. Meter shall retain memory during power outages.
- E. Meter shall be UL listed, CSA approved, and certified by a nationally recognized independent test facility to ANSI C12.16 specifications. Metering accuracy shall be $\pm 0.5\%$.
- F. Multiple meters shall have the ability to be connected by two-wire communication to interface module and RS232/485 port of host computer.
- G. Provide a PC with software to allow reading and monitoring the meters. The PC shall meet the following minimum specifications:
 - 1. CD-Rom Drive
 - 2. 16 GB RAM, 500 GB Hard Drive Space Available
 - 3. Color LED Monitor
 - 4. RS-232 Serial or USB port
 - 5. Modem and Ethernet
 - 6. Real-Time Clock
 - 7. Microsoft Windows XP or Windows 7.
- H. Provide energy software as defined here in this specification. Energy software shall operate with the PC specified in this section. Energy software shall provide for reading kilowatt hours and demand from the data recorder connected to meters and provide this information for analysis and/or billing.
- I. The Energy Software shall have or be capable of:
 - 1. Reading utility type meters via data recorder such as gas, water, electric, BTU, steam, etc. equipped with a pulse output.
 - 2. Reading "real-time" data from meters (kW, kVAR, kVa, Amps, Volts, Power Factor and Frequency).
 - 3. Printing out electric bills and usage information.
 - 4. Graphic capabilities (profile) to provide analytical charts and graphs, with demand profiling for 5-, 15-, 30- or 60-minute sampling rates.
 - 5. Supporting declining block tariffs, up to eight time-of-use rates and up to four seasonal rates.
 - 6. File export to spreadsheets for specialized applications.
 - 7. Reading gas, water and other meter types with pulse output.
 - 8. Supporting 1,000 locations.
 - 9. Exporting MV-90 (hhf) files.
- J. Provide data recorder same as E-Mon IDR-16 Interval Data Recorders or approved equal. Each IDR-16 shall read and record up to 14 meters, leaving 2 spares per recorder. See drawings for number of meters.
- K. The entire electronic metering system shall be Web-Enabled Energy Monitor system. Provide all required modules including interface modules with Ethernet Connection ports similar to Web-Mon interface module or approved equal. Provide adequate number of modules to ensure a complete operational system.
- L. Provided 8 hours of onsite programming and two hours of training of the system to the Owner.

2.16 HEAT TRACING SYSTEM FOR PIPES

- A. General

1. Furnish and Install a complete UL Listed, or FM Approved system of heating cables, components, and controls to:
 - a. Prevent pipes from freezing.

B. Materials

1. All components of the heat tracing system shall be manufactured by a single manufacturer.
2. The self-regulating heating cable shall consist of two (2) 16 AWG nickel-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. The heating cable shall be covered by a radiation-crosslinked, modified polyolefin dielectric jacket. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper and an outer jacket of:
 - a. Modified polyolefin (-CR) for freeze protectionas required per the National Electrical Code, Article 426. For installation on plastic piping, the heating cable shall be applied using aluminum tape (AT-180).
3. In order to conserve energy and to prevent overheating, the heating cable shall have a self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heating cable output going from 40° F pipe temperature operation to 150° F pipe temperature operation.
4. The heating cable voltage shall be as indicated on the drawings. Limit lengths of heat trace to 180 ft. for 30A-120V and 250 ft. for 30A-208/277V cable.
5. The heating cable shall operate online voltages of 120V, 208V, 220V, 240V, or 277V without the use of transformers.
6. The heating cable for metal-pipe freeze protection shall be sized according to the table below. The required heating cable output rating is in watts per foot at 50° F. (Heating cable selection based on 1" (25mm) fiberglass insulation on metal piping.). For PVC pipe, adjust wattage to manufacturer's recommendation.

Pipe size (inches)	Minimum Ambient Temperature	
	0°F	-20°F
3 or less	5 watts	5 watts
4	5 watts	8 watts
6	8 watts	8 watts
8	8 watts	2 strips-5 watts
10	2 strips-5 watts	2 strips-8 watts

7. The heating cable shall be XL-Trace cable as manufactured by Raychem Corporation or approved equal by Cromolux, Thermon or Delta Therm.
8. Power connection, end seal, splice, and tee kit components shall be applied in the field.

9. Ground fault protection required. Heating cable circuit shall be protected by a ground-fault device for equipment protection. This requirement shall be in accordance with the National Electrical Code, Article 426.

C. Components

1. All heating-cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable. All components that make an electrical connection shall be re-enterable for servicing. No component shall use silicone to seal the electrical connections. An exception will be made in areas where a conduit transition is required.

D. System Control shall be as follows, provide GFI protection, and direct control for single circuits or manufacturers appropriate contactor for multiple circuits.

1. Thermostatic Control–Ambient Sensing
 - a. The system shall be controlled by an ambient sensing thermostat AMC-1A variable set point set at 40°F with GFI circuit protection and multi-pole contactor as required.

E. Installation

1. System shall be installed per manufacturer's recommendations.
2. Apply the heating cable linearly on the pipe after piping has been successfully pressure-tested. Secure the heating cable to piping with fiberglass tape.
3. Apply "Electric Traced" labels to the outside of the thermal insulation.

F. Tests

1. After installation and before and after installing the thermal insulation, subject heating cable to testing using a 2500-VDC Megger, Minimum insulation resistance shall be 20 mega ohms or greater.

2.17 SURGE PROTECTION DEVICES (SPD)

A. Manufacturers

1. Eaton
2. Square D
3. Siemens
4. GE
5. Liebert
6. Current Technologies

B. Voltage Surge Suppression – General

1. Electrical Requirements
 - a. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

- b. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
- c. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.
- d. Unit shall operate without the need for an external overcurrent protection device (OCPD), and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.
- e. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

- f. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
- g. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

Modes	208Y/120
L-N; L-G; N-G	700
L-L	1200

- h. SPD Unit shall have a short circuit rating equal to or greater than that of the equipment it protects.

2. SPD Design

- a. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections

shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

- b. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
- c. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
 - 1) Type 2 units with filtering shall conform to UL 1283 5th Edition
 - 2) Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.
- d. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
 - 1) Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
 - a) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
 - b) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes
 - c) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
 - 2) Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

- 3) Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of $50 \pm 20A$ occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
 - a) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

e. Thermal MOV Protection

- 1) The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

f. Safety Requirements

- 1) The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

C. System Application

1. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
2. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	200 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

D. Lighting and Distribution Panelboard Requirements

1. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
 - a. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection
 - b. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 - c. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
 - d. The panelboard shall be capable of re-energizing upon removal of the SPD.
 - e. The SPD shall be integral to the panelboard and connected directly to the bus. Alternately, an integral SPD can be connected to a circuit breaker for disconnecting purposes, in the case a disconnect is required.
 - f. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
 - g. The SPD shall be of the same manufacturer as the panelboard.
 - h. The complete panelboard including the SPD shall be UL67 listed.

E. Service Entrance requirements

1. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments.

F. SPDs shall be supplied by a single manufacturer.

1. Acceptable manufacturers for service entrance (no substitutions):
 - a. Interceptor II.
 - b. LEA Corporation Powervantage.
 - c. Current Technologies SEL Series.
 - d. Manufacturer of distribution equipment for project where SPD is integral to equipment.

2. Acceptable manufacturers for branch panel and MCC applications (no substitutions):
 - a. Liebert Accuvar.
 - b. LEA Corporation SP Series.
 - c. Current Technologies TG Series.
 - d. Manufacturer of distribution equipment for project where SPD is integral to equipment.
- G. Provide labor, materials, equipment, services and transportation necessary for complete and operational systems as indicated on the Contract Drawings and specified herein, including, but not limited to, the following:
 1. Main Service Switchboard/Panel.
 2. Main Distribution Panel.
 3. Diagnostic Test Set.
 4. Factory Startup and Certification.
 5. Annual Maintenance/Testing Contract.
 6. Owner Training.
 7. Shop Drawing Submittals.
- H. The SPD system shall utilize multiple bi-direction, replaceable protection modules per each mode of protection to suppress and divert transient voltages and surge currents. The system shall be designed to provide protection for sensitive electronic devices against the harmful effects of surges, transients and electrical line noise.
- I. The SPD system shall comply generally with this specification and be tested and listed where applicable in accordance with the following specified standards:
 1. ANSI/IEEE C62.41
 2. ANSI/IEEE C62.45.
 3. Military Standard 220A.
 4. Underwriters Laboratory – UL 1449 Latest Edition with proper AIC rating
 5. Underwriters Laboratory UL67.
 6. Underwriters Laboratory UL847.
 7. NEMA LS-1-1992.

2.18 MOTOR CONTROLLERS

- A. All motor starters, including three phase magnetic combination and single phase manual types, shall in general be furnished under Division 23, but installed and wired under Section 26 10 00. Disconnect switches, except as furnished under Division 22, shall be provided under Section 26 10 00. Install disconnect switches furnished under Division 22.

2.19 OCCUPANCY SENSOR SWITCHES AND LOW VOLTAGE LIGHTING CONTROL SWITCHES

- A. Occupancy Sensors:
 1. Where indicated, provide wall mounted, wall-switch type, occupancy sensors. Provide ultrasonic type in areas with obstructed views of the room. Provide infrared type in small rooms with unobstructed views. Provide off-auto-on switch. Provide cover to block use of on switch such that occupant only has option of off-auto. Provide features similar to ceiling mounted units. Provide dual circuit type for rooms with dual switch control from same circuit.

2. Where indicated, occupancy sensors shall be ceiling or wall mounted dual technology passive infrared and ultrasonic occupancy sensors. Occupancy sensors shall be Wattstopper DT-200 for wall mounted and DT-300 for ceiling mounted or approved equal.
 - a. The occupancy sensors shall be capable of detecting presence in the floor area to be controlled, by detecting Doppler shifts in transmitted ultrasound.
 - b. The ultrasonic frequency shall be 40 kHz at 0.006%. Occupancy sensors shall be precision crystal controlled and shall not interfere with each other when two or more are placed in the same area.
 - c. Detection shall be maintained when a person of average size and weight moves only within or a maximum distance of 12" either in a horizontal or vertical manner at the approximate speed of 12" per second. The sum of this distance, volume, and speed represent the average condition occupancy sensors must meet in order that the lights not go off when a person is reading or writing while seated at a desk.
 - d. Each sensor shall be furnished with a convenient shunt provision, which will enable a custodian or building engineer to bypass the sensor in the event of a failure. This bypass provision pin or device shall remain in the sensor and be visible from the floor as a constant reminder that the automatic function has been bypassed.
 - e. The sensors are to be white, ceiling mounted (without protruding more than 1.5" (38mm)), and should blend in aesthetically with the ceiling.
 - f. Sensors shall have a multi-directional transmitter with temperature and humidity resistant tuned ultrasonic receivers.
 - g. If a power failure of more than two seconds occurs during unoccupied times, the lights shall not come on automatically when power is restored. If a power failure occurs during occupied times for less than three minutes, occupancy sensors shall have a memory which turns the lights back on without the need of initial motion.
 - h. Sensors shall be wired in parallel to allow coverage of large areas.
 - i. Time delay range shall be adjustable from 15 seconds to 15 minutes.
 - j. Sensitivity adjustment shall range from off at "0" to maximum at "10."
 - k. Occupancy sensors shall be NRTL listed products.
 - l. Sensors shall operate on 24V DC power, current draw of 25 milliamps.
 - m. Provide a dedicated power supply for each control zone. Provide additional power supplies for HVAC controls and controlled receptacles. Power supply shall be a UL listed Power Pack that consists of a transformer and contact closure relay in one package. Power output of the transformer shall be 100 ma, 24 VDC, and shall be capable of operating a minimum of four occupancy sensors.
 - n. Power switch packs shall have a ½" (13mm) threaded nipple for attachment to standard ½" (13mm) knockout enclosures.

- o. Sensors shall be suitable for use with Electronic ballasts without any interference or operational problems.
 - p. Detection modes (ultrasonic, infrared, or combined) shall be adjustable by the user. Set all units to combined operation initially.
 - q. Provide with manufacturer's adjustable (combination up/down and side to side) mounting brackets.
 - r. Where sensors are indicated as vacancy type, set the sensors to "VACANCY" mode.
3. Provide low voltage lighting control switches where indicated. The low voltage lighting control switches shall provide on/off or on/off and dimming control as indicated. Provide 3-way and 4-way combinations of switches where indicated. Low voltage lighting control switches shall be white, unless another finish color is selected by the architect, and shall be product of the same manufacturer and compatible with the occupancy sensors.

2.20 LIGHTING

- A. Provide all lighting fixtures complete with all accessories required for proper installation and operation.
- B. The lighting fixtures scheduled on the Drawings are indicative of the type and characteristics required.
- C. Fixtures submitted shall meet the requirements of utility incentive programs for energy efficiency. Contact utility company for information. Cooperate and coordinate with utility for incentive program. Incentives shall go to the Owner. Provide information and fill out forms as requested.
- D. Assume all responsibility for checking Architectural Drawings, prior to ordering fixtures, and provide the specified recessed fixtures with proper mounting arrangement to be compatible with the type ceiling construction in which the fixture is to be mounted.
- E. Submit manufacturer's submittals for all lighting fixtures for review and acceptance prior to purchase.
 - 1. Submittals shall indicate complete details of fixtures including the Manufacturer's catalog numbers for drivers, engines, light shields, switches, metal gauges, type of wiring, finish color, and texture.
 - 2. Where pertinent to proper installation or operation, submittals shall indicate relationship between fixtures and adjacent elements of structure (walls, columns, ducts, openings, ceiling grid, etc.).
 - 3. Submit verification of meeting utility incentive program requirements.
 - 4. Submit photometric information.
 - 5. Submit point-by-point calculations for substituted fixtures and where requested.
- F. Fixtures shall be free of light leaks. No cross bars are permitted over light shields. Fixtures shall provide for sufficient ventilation of lamps and ballasts. Size and location of

vent holes shall be indicated on Manufacturer's Drawings. Outdoor fixtures shall have wire mesh screens in the vent holes.

- G. Assume all responsibility for the safe handling of all lighting fixtures, accessories, and lamps until the final inspection has been made by the Architect and the installation accepted by the Owner.
- H. Supply special fittings and materials that may be required to support fixtures as well as supports, spacers, or grounds required to secure surface or pendant mounted fixtures on suspended ceilings.
- I. Replace fixtures, or parts thereof, determined to be damaged or defective.
- J. Recessed fixtures shall be supplied with trim gaskets as required to prevent light leaks on ceiling. Provide mounting support bars for all recessed fixtures as required.
- K. Fixtures to be located outdoors or indoors in ambient temperatures that may be below 60°F, shall have outdoor LEDs and drivers suitable for operation at 0°F.
- L. All LED fixtures shall be covered by a three-year warranty against defects and warranty shall include payment for labor costs of replacement of inoperative "in-warranty" LED fixtures.
- M. Provide manpower and tools for final adjusting of all adjustable fixtures. This operation shall take place immediately before the building is turned over to the Owner after regular working hours where required.
- N. Power Supply Unit (Drivers)
 - 1. Luminaires shall be equipped with an L.E.D. driver(s) that accepts the voltage as indicated on the Light Fixture Schedule. Individual driver(s) shall be replaceable.
 - 2. Driver(s) shall be UL8750 class 2 compliant for their intended purpose.
 - 3. Total harmonic distortion (THD) for current: $\leq 20\%$.
 - 4. Driver(s) shall be rated to operate between -30°C to 50°C minimum.
 - 5. Individual driver(s) shall be equipped with surge protection (6 kV minimum) in accordance with IEEE/ANSI C62.4.1. Driver shall be protected against damage due to either an open circuit or short circuit fault condition on the driver output.
 - 6. Driver(s) shall have a minimum efficiency of 85%.
 - 7. Drivers shall deliver full-range dimming from 0-10V control signal.
- O. L.E.D. Light Source (Light Engine)
 - 1. Individual light engine(s) shall be replaceable.
 - 2. L.E.D. light engine(s) shall have a minimum lifetime of 50,000+ hours at 40°C and shall have a minimum efficiency of 80 lumens per watt.
 - 3. L.E.D. dies shall be tested in accordance with I.E.S.N.A. LM-80-08 standards.

4. Thermal management shall be passive by design and shall consist of heat sinks with no fans, pumps or liquids.
5. All L.E.D. lamps shall be binned to ensure uniformity on lamp color and light output.

2.21 TELECOMMUNICATIONS SYSTEMS PROVISIONS

- A. Provide a telecommunications raceway system for telephone and data.
- B. In general, the telecommunications system raceways, outlets and terminal backboard locations shall be as indicated on the Drawings.
- C. All work and the entire installation of same shall be coordinated with the Owner and the Telecommunications System, Installers before the start of the construction and shall be in full conformance with their requirements and recommendations.
- D. Provide blank device outlet cover plates for all outlets without device plates installed at time of Substantial Completion. All outlet cover plates shall be of the same finish material and by the manufacturer furnishing all other device and switch plates installed throughout the buildings.
- E. Provide 1" conduit unless otherwise indicated from outlets indicated on the Drawings into the nearest partition, extended a minimum of 6" (152mm) above an accessible ceiling or to the backboard if there is no nearby accessible ceiling. Terminate with insulated throat fittings. Provide 90-degree bend at top of wall. Provide 4" square by 2-1/8" deep box with single gang plaster ring for each outlet, unless otherwise indicated.

2.22 ACCESS PANELS

- A. Furnish access panels as specified in sections 08310 and 20 05 00 for access to electrical equipment and devices that are concealed. Access panels shall be installed under other sections.

2.23 GROUNDING

- A. Provide grounding system and components that meet the Electrical Code and are NRTL listed for the purpose.
- B. Provide copper clad steel ground rods 3/4" (19mm) diameter and 10' (3048mm) long unless otherwise indicated.
- C. Grounding connections shall be made by means of approved and listed bronze clamps equal to Burndy type GBM, compression connections, or exothermic welding.
- D. Ground conductors shall be of electrical grade copper except where otherwise indicated.
- E. Grounding connector shall be uninsulated unless otherwise indicated.

2.24 SEALS

- A. Water Tight Seals
 1. Conduits entering from the exterior or below grade shall have water tight fittings on the outside and on the inside of the conduit.

- a. Fittings on the outside of the conduit shall be O-Z Gedney type FSK or approved equal. Provide type WSK if penetration is within 2' (610mm) of the high water table. Provide grounding attachment. Utilize like seals or equal for penetrations of existing foundations/slabs.
 - b. Fittings on the inside of the conduit shall be O-Z Gedney type CSBI or approved equal. Provide type CSBG if penetration is within 2' (610mm) of the high water table. Provide a blank fitting to seal spare or empty conduits.
 - c. O-Z Gedney type CSM fitting may be used when sealing within a sleeve or cored hole.
2. Submit on seals to be used.

B. Environmental Seals

1. Provide seals on raceways exposed to widely different temperatures, as in refrigerating or cold storage areas. Install seal to prevent circulation of air from warmer to colder sections through the raceway.

C. Smoke and Fire Stopping Seals

1. Provide a seal around raceways or cables penetrating full height walls (slab to slab), floors, or ventilation or air handling ducts so that the spread of fire or products of combustion shall not be substantially increased.
2. Penetrations through fire-resistant-rated walls, partitions, floors, or ceilings shall be firestopped using approved methods and NRTL listed products to maintain the fire resistance rating.
3. Installation restrictions of the listing agencies shall be strictly adhered to (e.g. 24" minimum horizontal separation between boxes on opposite sides of the wall, maximum square inch opening in wall).
4. Fire stopping in sleeves or in areas that may require the addition or modification of installed cables or raceways shall be a soft, pliable, non-hardening fire stop putty. Putty shall be water resistant and intumescent. Provide for all sleeves and raceways.
5. Firestopping in locations not likely to require frequent modification shall be a NRTL listed putty, caulk, or mortar to meet the required fire resistance rating.
6. Box penetrations into a fire rated wall or shaft shall have a fire stopping pad installed on the back of the box.
7. Firestopping materials shall be NRTL listed to UL 1479 (ASTM E814). Installation methods shall conform to a UL firestopping system. Submit specifications and installation drawings for the type of material to be used. Firestopping materials shall be as manufactured by 3M, International Protective Coatings Corp., Specified Technologies, Inc., Carborundum Company, RayChem, or approved equal.

2.25 VIBRATION ISOLATION

- A. Vibration control devices, materials and related items. Perform all work as indicated on the Drawings and as specified herein to provide complete vibration isolation systems in proper working order.
- B. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate dimensions and size of housekeeping pads.
- C. Provide vibration isolators of the appropriate sizes and proper loading to meet the specified requirements.
- D. Provide any incidental materials needed to meet the requirements stated herein, even if not expressly specified or indicated on the Drawings.
- E. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.
- F. Should any equipment cause excessive noise or vibration, provide remedial work to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.
- G. Upon completion of the work, the Architect shall inspect the installation and shall inform of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.
- H. The shop drawing submittal for isolated electrical equipment shall include submittal information for the isolation mounts. Information supplied shall be as follows:
 - 1. A complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.
 - 2. Detailed selection data for each vibration isolator supporting equipment, including:
 - a. The equipment identification mark.
 - b. The isolator type.
 - c. The actual load.
 - d. The static deflection expected under the actual load.
 - e. The additional deflection-to-solid under load.
 - f. The ratio of spring height under load to spring diameter.
- I. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job. Provide for all costs associated with submission of samples.
- J. Vibration Isolation Type DNP (Double Neoprene Pad)
 - 1. Neoprene pad isolators shall be formed by two layers of 1/4" (6.4mm) to 5/16" (8mm) thick ribbed or waffled neoprene, separated by a stainless steel or aluminum plate. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
 - 2. Manufacturers
 - a. Amber/Booth - Type NR.
 - b. Korfund Dynamics - Type Korpapad.

- c. Mason Industries - Type WSW.
- d. Kinetics Noise Control - Type NPS.
- e. Vibration Mounting and Control - Series Shear Flex.
- f. Substitution: or equal, under provisions indicated.

K. Vibration Isolation Type HN (Hanger Neoprene)

- 1. Vibration isolation hangers shall consist of neoprene-in-shear or glass fiber element contained in steel housing. Neoprene neck bushing (or other element) shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30 degree arc before contacting the hanger housing.
- 2. Type HN isolators shall be one of the following products or approved equal:
 - a. Amber/Booth - Type BRD-A.
 - b. Korfund Dynamics - Type H.
 - c. Mason Industries - Type HD.
 - d. Kinetics Noise Control - Type RH or FH.
 - e. Vibration Mountings and Control - Type RHD or RFD.
 - f. Substitutions: or equal, under provisions indicated.

L. Vibration Isolation Type FSNTL (Floor Spring and Neoprene Travel Limited)

- 1. Spring isolators shall be free-standing and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Spring shall have a minimum additional travel-to-solid equal to 50 percent of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one. All mounts shall have leveling bolts. All mounts shall have vertical travel limit stops to control extension when weight is removed. The travel limit stops shall be capable of serving as blocking during erection of the equipment. A minimum clearance of 1/4" (6.4mm) shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.
- 2. Either the spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene, or each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, provide a rectangular bearing plate of appropriate size to load the pad uniformly within the manufacturer's recommended range. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel, or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate, and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.
- 3. Manufacturers
 - a. Amber/Booth - Type CT.
 - b. Korfund Dynamics - Type WSCL.
 - c. Mason Industries - Type SLR.
 - d. Kinetics Noise Control, Inc. - Type FLS.
 - e. Vibration Mounting and Controls, Inc. - Series AWR.
 - f. Substitutions - or equal, under provisions indicated.

M. Vibration Isolation Type NP (Neoprene Pad)

1. Neoprene pad isolators shall be one layer of 1/4" (6.4mm) or 3/8" (9.5mm) thick ribbed or waffled neoprene. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
 2. Manufacturers
 - a. Amber/Booth - Type NR.
 - b. Korfund Dynamics - Type Korpad.
 - c. Mason Industries - Type W.
 - d. Kinetics Noise Control, Inc. - Type NPS.
 - e. Vibration Mounting and Controls, Inc. - Series Shear Flex.
 - f. Substitutions must be equal under the provisions indicated.
- N. Flexible Electrical Connections
1. Type A
 - a. Flexible Electrical Connection Type A shall be an expansion/deflection prefabricated unit incorporating a flexible and watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wire way, and end hubs with tapered electrical threads to fit standard threaded rigid metal conduit.
 - b. Manufacturers
 - 1) Crouse-Hinds (Syracuse, NY) - "XD".
 - 2) Spring City Electrical Mfg. Co. (Spring City, PA) - Type DF.
 - 3) O.Z. Gedney.
 - 4) Substitutions must be equal under provisions indicated.
 2. Type B
 - a. Flexible Electrical Connection Type B shall be field fabricated using a minimum 3' (914mm) length of liquid-tight flexible conduit or cable.
- O. Grommets
1. Grommets shall be custom made by combining a neoprene washer and sleeve. Grommets shall be sized so that they will be loaded within the manufacturer's recommended load range. Grommets shall be specifically formed to prevent bolts from directly contacting the isolator base plate.
 2. Manufacturers
 - a. MBIS, Inc. (Bedford Heights, Ohio) – Isogrommets.
 - b. Barry Controls (Watertown, MA) - Series W.
 - c. Substitutes must be equal under the provisions indicated.

PART 3 - EXECUTION

3.1 REFERENCE

- A. Refer to Section 28 30 00, Fire Alarm System for Low Rise Buildings.

3.2 SPECIAL RESPONSIBILITIES

- A. Do not install equipment and materials, which have not been reviewed by the Architect. Equipment and materials, which are installed without the Architect's review or without complying to comments issued with the review, shall be removed from the project when so instructed by the Architect. No payment will be made for the removal of unapproved materials or equipment if it is ordered removed. The Installer shall be responsible for any ancillary costs incurred because of its removal and the installation of the correct equipment and materials.
- B. Request, in writing, that the General Contractor and each Trade prepare and submit to this Section a complete list of all equipment which they are supplying under their respective Sections which require electric power, electric connections, electric control wiring, or work under this Section.
- C. Obtain detailed information on installation requirements from the manufacturers of all equipment to be furnished, installed, or provided. At the start of construction, check all Contract Documents, including all Drawings and all Sections of the specifications for equipment requiring electrical connections and service and verify electrical characteristics of equipment prior to roughing.
- D. Request the General Contractor to provide, as soon as possible after approval, two copies of approved submittals of equipment which requires electric service, electric connections, or electric controls. Review these submittals for electric characteristics including voltage, amperes, wattage, and horsepower and return the submittals to the General Contractor noting any non-agreement within two weeks of receipt.
- E. Equipment and systems shall not be installed without first coordinating the location and installation of equipment and systems with the Architectural drawings, General Contractor and all other Trades. Any and all material installed or work performed in violation of above requirements shall be re-adjusted and corrected by the Installer without charge.
- F. Assure that all electrical equipment is accessible, such as junction boxes, pull boxes, panelboards, switches, controls, and such other apparatus as may require maintenance and operation from time to time. Provide necessary construction access panels sized to provide adequate and required access for installation by the General Contractor. Provide rated panel or door appropriate for the construction being installed into fire, smoke and/or acoustical construction.
- G. After installation, electrical equipment shall be protected to prevent damage during the construction period. Openings in conduits and boxes shall be closed to prevent the entrance of foreign materials.

3.3 ELECTRICAL DEMOLITION AND RENOVATION WORK

- A. Shut-off, disconnect, make safe and dismantle existing electrical systems to be demolished and leave electrical equipment and debris on floor for removal by the General Contractor. Disconnect existing electrical equipment to be demolished and identify items to be removed with orange spray paint for removal and disposal by the General Contractor.
- B. Scope of demolition shall be as indicated on the design drawings and as indicated in these specifications. Carefully examine the Drawings and visit the site to determine the extent of this work.
 - 1. Identify, prior to demolition and work beginning, electrical work that is to remain and that which is to be removed. Use spray paint color code that does not conflict with the color code indicated under "IDENTIFICATION" or color code used by existing, otherwise, tie colored ribbon in lieu of paint. Post color code in

- conspicuous area. The location of existing work is approximate. Determine exact location prior to performing work.
2. Power to areas and equipment being demolished shall be disconnected and made safe.
 3. Electrical items that are to be relocated shall be carefully examined and checked for defects prior to removal. Defects shall be brought to the immediate attention of the Architect. After equipment has been certified to be in good condition, it shall be relocated and cleaned. Failure to identify, in writing, to the Architect defective existing work, indicates all existing is in good condition. Equipment damaged in this process shall be replaced with new equipment or repaired to the satisfaction of the Architect.
 4. Removed equipment, fixtures, and wire shall be offered to the Owner. Legally dispose of fixtures, equipment and material not retained by Owner.
 5. Maintain the existing building in electrical operation at all times during the entire construction period. If it is necessary to have an electrical shutdown, a written request for approval shall be submitted in advance stating the estimated shutdown time. Work shall be planned to minimize shutdown. Shutdowns shall be at the convenience of the Owner and, if necessary, on premium time.
 6. Disconnect electrical circuits in the way of demolition work, and reestablish circuits to remaining outlets and equipment.
 7. Where new ceilings or wall coverings are installed, provide new box covers and extension rings as required on existing outlets.
 8. Provide blank, flush plates on abandoned outlets. Material and finish as directed by the Architect.
 9. Dispose of environmentally sensitive materials (insulating oils, PCBs, ballasts etc.) as required by the authority having jurisdiction.
- C. Existing conductors and cables run above ceiling, not run in metal raceway and not plenum rated, shall be disconnected, removed and replaced so as to be suitable for air handling plenums, per local, state, and national codes.
- D. Existing systems may only be re-used where they are specifically indicated to be re-used. The work of this Section includes being responsible for verifying the mechanical integrity of any existing raceway systems that are to be reused. Where the existing raceway system does not meet the requirements indicated in the electrical specifications, the raceway system shall be repaired or replaced before new wiring is installed.
- E. All existing exposed raceways and raceway components that are not to be reused shall be demolished. Where existing raceways are embedded in building construction, they shall be cut flush with finished surfaces and abandoned in place. All existing wiring shall be removed.
- F. The work of this section includes supporting existing telecommunications cabling that is resting on the existing ceiling. Provide J hooks to support the existing cabling after the removal of the ceiling and/or ceiling tiles.

3.4 PREMIUM TIME WORK

- A. The cost of premium time, overtime, overhead, profit and all associated costs for work specified shall be part of the cost of the work of this Section and shall not be part of any other Allowance for the cost of premium time, overtime and associated costs.
- B. The following items of work shall be done on the premium time between the hours of 6:00 A.M. to 6:00 P.M. Saturday/Sunday and 5:00 P.M. to 7:00 A.M. Monday through Friday or as required by the Building Representative.
 - 1. Electric service (emergency or normal) shutdown (de-energize).
 - 2. Any switchboard shutdown.
 - 3. Shutdown (de-energizing) any panelboard or feeders.
 - 4. Work on or about, or the shutdown of, electrical distribution equipment which supplies or is required for the operation of Owner's equipment and support equipment for Owner's equipment.
 - 5. Work on or about, or the shutdown of, mechanical equipment and distribution which supplies or is required for the operation of computers or computer rooms or spaces.
 - 6. Cutting, drilling, core drilling, or similar work which disturbs or interferes with the Owner's work or production.

3.5 GROUNDING

- A. The electrical service and distribution systems, comprising of transformers, switchgear switchboards, distribution panels, all electric circuits, raceways, cabinets, motors, boxes, devices, battery racks and non-current carrying metallic parts shall be grounded according to the Electrical Code.
- B. A separate copper grounding conductor shall be installed with all feeders, and branch circuit wiring systems. The grounding conductor shall have insulation type to match that of the normal current carrying conductors and sized to comply with requirements of the Electrical Code and other governing agencies. The grounding conductor shall be properly identified with green tape or insulation where visible in boxes or outlets.
- C. Grounding network for building shall comprise:
 - 1. Connection to metallic water service.
 - 2. Connection to all metallic building systems.
 - 3. Connection to building steel.
 - 4. Driven $\frac{3}{4}$ " x 10'-0" copperclad steel ground rods connected in a counterpoise configuration.
- D. System shall be measured to achieve 5 ohms when tested against a single ground rod. Provide additional drive ground rods, buried copper mesh, or copper plates to achieve 5 ohms.
- E. Methods:
 - 1. The ground connections of conductor system shall be made at the main service equipment and shall be extended to the point of the metallic water service. Main connections shall be made on the street side of any meters and flanged pipe. Provide bonding jumpers across meters and insulated flanges, as required, to

maintain continuity. Connections shall be made readily accessible for inspection. No connections shall be made concealed in floors or walls.

2. All permanent grounding connections shall be exothermic welded connections as required by code using new and unused molds of the specific type for the connection to be made. "Cadweld" or "Thermoweld" processes are acceptable.
3. All bus connections shall be made suitable NEMA two hole type copper compression connectors.
4. All equipment connections shall be made with clamp type copper connectors.
5. Connections to the cold water service pipes shall be with bronze pipe grounding clamp.
6. Motor frames shall be grounded by the equipment grounding conductor run in the same raceway as the power leads.
7. Provide bonding jumper across expansion/deflection fittings.
8. Install ground rods vertically 24" minimum below finished grade. Spacing between ground rods shall not be less than the length of the rod.
9. Exposed connections between different metals shall be sealed with non-oxide paint grade A or equal.
10. In new construction bond to masonry reinforcing bars.

F. Equipment Grounding:

1. The frames of all electrical equipment including motors, panels, and lighting fixtures shall be grounded to the equipment grounding conductor.
2. Ground busses shall be 2-1/4" copper mounted, 18" (457mm) above the finished floor, insulated from the wall.
3. Raceways, devices and equipment that have friction grounds shall have the paint removed from the areas of contact.
4. Each panelboard shall be equipped with an insulated terminal strip for neutral conductors and an equipment grounding bus bonded to the panel case, each with sufficient terminals for the number of circuits. The equipment ground bus shall be connected directly to ground via a green grounding conductor. The point of grounding shall be at the point of supply.
5. Where conduits are stubbed up out of the floor into a panel with no bottom, grounding bushings shall be used. The ground conductor connecting the bushings to the ground stub on the panel shall be sized per Electrical Code Table 250-95.

G. Tele/Data Grounding

1. Bond raceways to the ground bus located in the Tele/Data closets/rooms. Bond raceways in each room they terminate in.

3.6 SLEEVING AND BUSHINGS

- A. Raceways and openings shall be laid out in advance to permit their provision in the work. Sleeves and raceway shall be set before masonry is constructed. Any extra work, including coring, required where sleeves or raceways have been omitted or improperly placed shall be performed at the expense of the Installer who made the error or omission.
- B. Provide sleeves for raceways, busways and cable trays penetrating floors, fire walls, or smoke partitions. Install approved material to provide for fire stop.
- C. Provide waterproof seals inside and outside raceway when penetrating from the exterior or underground.
- D. Provide acoustic sealer in sleeves between occupied spaces.
- E. Provide sleeves in masonry construction and in full height (slab to slab) walls.
- F. Provide sleeves for any openings requiring fireproofing.
- G. Provide bushings in all metal studs and other openings where cables shall pass through. Bushings shall be of two piece construction with one piece inserted through the opening and the second piece locking it into place. Single piece bushings with locking tabs or friction fit are specifically prohibited.

3.7 WIRING METHODS

- A. Generally, unless specified below and approved by the Authorities having jurisdiction, wiring shall consist of insulated conductors installed in rigid steel conduit with threaded connection. Electrical metallic conduit may be used as permitted by State or Local Codes for feeders, branch circuits, signal, instrumentation, and control circuits.
 - 1. EMT may be used as permitted in ceiling or floor cavity spaces, void spaces of masonry walls, in equipment rooms, in mechanical chases, in electrical chases, in closets, in exposed locations 8' (2438mm) above finished floor and where not subject to accidental damage or abuse. Where subject to accidental damage or abuse, and/or where in wet or damp locations, install in rigid steel conduit.
 - 2. Install low voltage in conduit where exposed or subject to abuse. In building voids install cabling as follows:
 - a. Security System: In conduits. Low energy, plenum rated cable supported by bridle rings, where concealed.
 - b. Bridle rings shall be supported by the building structure.
 - c. Do not install more than thirty cables in any one bridle ring.
 - d. Group cables of each system together and bind with plastic tie-wraps. Provide identification tag every 10' (3m) for each system, color coded as indicated under Part One Identification.
- B. Metal clad (MC) Cable with a full size, insulated, separate ground wire may be used as permitted by state, Local and Electrical Authorities and codes for branch circuit wiring as follows:
 - 1. In studded partitions and above hung ceilings only. Install wiring in conduit where exposed, visible, or surface mounted.
 - 2. Install MC cabling using suitable clips and supports equal to Caddy CC Series or KX Kon clips (or equal by B-Line) on 1/4" (6.4mm) threaded rod. Maintain proper

spacing between cables. Support cable from structure and not from ceiling support system or other trade's work.

- C. All exposed risers, risers from underground, penetrations of walls or concrete slabs shall be made with rigid steel conduit and minimum radius bend of ten times the raceway diameter. Provide expansion fitting placed between exit at ground and fixed terminus. Bond to ground.
- D. Flexible metal conduit, 39" in length, shall be provided at all motors and equipment subject to vibration or movement. Liquid-tight flexible conduit shall be used in wet or damp locations. Refer to vibration isolation requirements.
- E. All raceways shall be properly fastened in accordance with the applicable Articles of the Electrical Code. Spacing between supports shall not exceed 7' unless specifically approved by the Architect. Raceways installed above suspended ceilings shall be supported from the building structure. Supports fastened to the roof decking shall not be allowed.
- F. Conduit joints shall be cut square, threaded, reamed smooth, and drawn up tight. Bends or offsets shall be made with standard conduit ells; field bends shall be made with an approved bender or hickey. Pipe threads cut in the field for exterior or underground use shall be painted with red lead or a similar approved substance before being made up.
- G. Minimum size conduit shall be 3/4". Other sizes shall be as indicated on the Drawings or as required by the Electrical Code for number and size of conductors installed.
- H. No combining of branch circuit wiring beyond three phase wires, neutral wire(s) and grounding conductor shall be allowed, unless specifically indicated.
- I. Provide individual conduit home runs for three phase motors as indicated on the Drawings.
- J. Conduit runs are shown diagrammatically. The exact routing and means of support shall be determined in the field. Exposed conduits shall be installed parallel with, or at right angles to, the building walls, structural members, or architectural features.
- K. All conduit ends shall be plugged or capped as soon as they are installed to prevent entrance of moisture or other debris during construction.
- L. All spare conduits shall have a nylon (200 lb. test) pull line inserted.
- M. Provide two expansion/deflection fittings wherever building expansion/deflection joints occur and in long runs of raceways for thermal movement. Expansion joints shall be provided for non-metallic conduit to compensate for thermal expansion and contraction as recommended by the manufacturer. Set fittings as recommended by the Manufacturer for the ambient temperature during installation. Set fitting at building expansion/deflection joints to allow movement equal to the building movement. At Seismic joints, provide two fittings, one on each side of the building joint with a piece of flexible raceway across the joint.
- N. Work supported on walls, columns, or steel work shall be held in place by caulking anchors, power-driven studs, expansion shields, beam clamps, or concrete inserts. Nails or screws used in conjunction with wood plugs in lieu of toggle or expansion bolts shall not be accepted.

- O. Connections between conduits of different types shall be made in an approved manner, using adapters or other materials and methods recommended or the purpose by the conduit manufacturers.
- P. All raceways shall be mechanically complete, carefully cleaned, blown and swabbed dry inside before installation of wires and cables. The Architect reserves the right to have all wiring in a raceway or raceways removed for inspection should the presence of moisture or dirt be suspected in same at no additional expense to the Architect. If moisture or dirt is found in the raceway system during the inspection of same, it shall be thoroughly cleaned and dried to the complete satisfaction of the Owner at no additional expense.
- Q. All floor mounted equipment shall be mounted on 4" housekeeping pads.

3.8 WIRE AND CABLES

- A. No conductors shall be installed into any raceway system until it is complete in all details and weather tight.
- B. Wires and cables shall be carefully handled during installation so as to avoid mechanical injury to the conductor, insulation, or covering.
- C. Joints and splices shall be made in an approved manner and be at least equivalent electrically and mechanically to the conductor itself. Whenever the conductors are bared for splicing, they shall be taped with a good grade of rubber splicing compound and friction or plastic tape so as to form at least the equivalent of the original insulation and covering. Provide a heat or cold shrink insulating wrap equal to 3M or RayChem.
- D. No splices or joints shall be permitted in either feeders or branch circuit conductors except at outlets or accessible junction boxes. Splices in wire #8 AWG and smaller shall be standard pigtail, made mechanically tight. Conductors for low voltage and life safety systems (including but not limited to Fire Alarm, Security, Sound, etc.) shall be terminated only on terminal strips in junction boxes in cabinets, no splices or joints will be allowed. Provide Sta-Kon or equal ring compression terminations.
- E. Provide labels identifying conductor and termination point for all low voltage systems at all terminations.
- F. Wire #6 AWG and larger shall be connected to panels and apparatus by means of approved lugs or connectors. Connectors shall be mechanical type, sufficiently large to enclose all strands of the conductor and be securely fastened. All solderless connections and lugs shall be by Trego, Inc., Burndy, T&B, or approved equal.
- G. Splices and taps in wires #8 and larger shall be made with Burndy, Anderson, or Kearney solderless connectors designed for the purpose. The splices and taps shall be taped with approved tapes providing insulation not less than that of the conductor. Splices shall be mechanically and electrically secure.
- H. Pressure connectors with "wrap caps" or insulating caps of a type approved by the local inspecting authorities may be used on branch circuits with conductor sizes up to and including #10 AWG. Connectors shall be manufactured by Buchanan, Eagle, Ideal, or approved equal. Provide caps suitable for use in wet conditions filled with insulating sealing compound for connections in wet, damp, or exterior locations.
- I. Insulating compounds, unless indicated or specified otherwise, for cable joints, boxes, terminals and other similar items, shall have bituminous base and shall be free from granular content, creosote alkali, acid, sulfur, and water.

- J. A lubricant manufactured by Ideal, , Dow Corning, or approval equal, shall be used when necessary for the pulling of conductors or cables into the raceway systems except that no pulling compound shall be used for isolated power system circuits.
- K. Stranded conductors #10 AWG and smaller shall use compression type insulated ring or fork tongue crimp terminals.
- L. Use ring tongue compression type terminations on screw type terminal blocks on Fire Alarm, Security System and low voltage wiring. Do not splice conductors. Label junction box and all wires.
- M. Minimum wire size shall be #12 AWG for power and lighting circuits and #14 AWG for control wiring. 120-volt branch circuits of more than 100' from center of load to panel shall be #10 AWG.

3.9 UNDERGROUND RACEWAYS

- A. Application - Provide the following installation methods unless otherwise indicated or as required by local authority:
 - 1. Electric conductors for generator circuits - concrete encased PVC Schedule 40 raceways.
 - 2. Sweeps and bends from underground - rigid steel conduit.
 - 3. Notify the Structural Engineer and get approval in writing for penetrations through masonry over 5" in any direction and for multiple openings under 5" within 39" of each other.
- B. Generally underground conduits shall comply with Wiring Method Section of this specification.
- C. The duct system shall consist of round bore raceways. The number and type of raceways in the duct shall be as indicated in the specifications and on the Drawings. Duct lines shall be laid to a minimum grade of 4" per 100'. Grade (pitch) may be from one manhole to the next, or both ways from a high point between manholes, depending on contour of the finish grade, so that all ducts shall empty out into the manholes. Ensure no water egress into building by sloping conduits entering building down away from building. Duct lines shall be installed so that the top of raceway is not more than 30" (762mm) below finished grade and not less than 18", except 24" in vehicular traffic areas, below finished grade at the high points.
- D. Changes in direction of runs exceeding a total of 10° either vertically or horizontally, shall be accomplished by long sweep bends (in five degree increments) having a minimum radius of curvature of 25' (7.6m), except that manufactured bends may be used at ends of short runs of 100' (30m) or less, and then only at, or close to, the end of the run. The long sweep bends may be made up of one or more curved or straight sections or combinations thereof. Bends shall have a minimum radius of ten times the conduit diameter.
- E. Where it is necessary to cut the tapered end on a piece of conduit at the site, the cut and/or taper shall be made with a special tool or a lathe, so that the new taper matches the taper of the particular conduit being used.
- F. Each single raceway of the duct bank shall be separated. Separators or spacing blocks shall be made of concrete, plastic, or other suitable non-metallic, non-decaying material placed on not greater than 4" centers.

- G. All raceways in the duct lines shall be securely anchored with non-metallic ties to prevent any movement during the pouring and spreading of concrete or backfill.
- H. All non-metallic conduits shall be handled and stored in such a manner as to avoid warping, cracking, or deterioration. Provide solvent weld connections.
- I. Where installed under the building support raceways from the building slab above at 6' maximum intervals.
- J. Backfill: The earth cover shall be void of all objects over 2" in any direction or decomposable material. Provide 6" of sand above and below direct buried (non-concrete encased) raceways or conductors.
- K. Provide detectable type 6" wide polyethylene/metallic warning tape 12" above the entire length of underground raceway and cables, including under buildings.
- L. For rigid steel conduit for risers and sweeps from underground including at service poles, transformers, equipment and through concrete slabs. Bond to ground. Provide expansion fittings with 4" minimum movement between exit at ground and fixed terminus. Include bonding jumpers and sufficient cable slack for the required movement. Set expansion fitting per Manufacturer's recommendations for the ambient temperature at the time of installation.
- M. Provide expansion fitting on risers from underground to compensate for any lifting or settling due to frost heaves.
- N. Spare raceways shall be plugged and sealed watertight at all manholes, handholes, buildings, and structures.
- O. Raceways with cables installed within shall be sealed watertight and gastight with appropriate fitting.
- P. Using appropriate fittings, seal between raceways and walls or floors where the raceways enter the building.
- Q. Coordinate with other work including site, utility and landscaping work, electrical raceway and wiring work as necessary to interface installation of underground raceways, vaults, manholes and handholes with other work.
- R. Coordinate and verify that concrete work is performed as indicated herein and on the Drawings. All concrete installed shall be monolithic, laid continuously until complete. If it is impossible to have a monolithic installation, the end of the concrete duct bank installation shall be sloped at a 30 degree angle and shall have #4 rebar on 12" (304mm) centers and 3" of cover, installed around the perimeter of the duct bank to tie into the next pour.
- S. Underground raceways shall be encased in a concrete envelope. There shall be a minimum of 4" of concrete on all sides and 3" between raceways.
- T. Raceway joints in concrete encasement may be placed side by side horizontally, but shall be staggered at least 6" vertically.
- U. Underground raceways crossing over pipelines or under areas subject to high vehicular traffic shall be encased in a steel reinforced concrete envelope. There shall be a minimum of 4" of concrete on all sides and 3" between raceways. Steel reinforcing shall consist of No. 4 steel rod spaced 12" on center each way, top and bottom and extend for 4' beyond the affected area on each side.

3.10 UNDERGROUND WIRING

- A. Generally underground wiring shall comply with Wire and Cables Section of this specification.
- B. Direct buried conduits shall be installed with a minimum cover of 24". There shall be 6" of sand under and 12" over the cables. The earth cover backfill shall be void of all objects over 2" in any direction or decomposable material. Conduit bushings shall be used where direct buried cables enter conduit system.
- C. All splices and terminations shall be made up by qualified and certified cable splicers pre-approved by the Architect. Procedures and materials shall be in strict accordance with recommendations of the Cable Manufacturer and as defined in the contract specifications. A copy of the recommendations shall be furnished to the Architect for review.
- D. Splicing and terminating materials shall be purchased in sealed moisture proof packages. Packages shall not be opened until the particular splice or termination is to be made. Care shall be taken to exclude moisture or voids from any splice. Connectors and lugs shall be of the heavy cast copper solderless compression type and shall be capable of accepting two 20 ton compressions. All large splices and terminations shall be built up before applying tape with electrical insulating putty to eliminate both sharp edges and voids. Splices between cables shall be staggered whenever possible.
- E. Cables to be spliced or terminated shall be trained and racked into their final positions before any cable is cut. Ends of cables to be spliced shall be cut so that they butt squarely together at the centerline of the splice.
- F. When a cable is opened for splicing or terminating, the work of splicing or terminating shall proceed immediately and continue uninterrupted until the splice or termination is completed, including any sealing required.
- G. Splices in jacketed cable shall be tapped sufficiently after completion of the splice to provide a protective jacket equal in all respects to the original cable jacket.
- H. Shielding shall be continued throughout splices. Terminations of shielded cables shall be equipped with stress cones. Grounding conductors in the interstices of cables shall be continued through splices. Outdoor exposed terminations in rubber-insulated shielded cables shall be equipped with rain shields. Connections to insulated buses shall be completely taped, including portions of buswork left exposed for connections.
- I. Proper supports shall be provided at each splice.
- J. The pulling cable shall be attached to a power winch of sufficient size to allow for a continuous pull of cable after the cable has entered the conduit. The mechanical stress placed upon the cable during installation shall not be such that the cable is excessively twisted, stretched, or flexed, and tension shall not exceed 90 percent of manufacturer's recommendations. Tension shall be measured by a dynamometer (strain gauge) on all cables. Hydraulic pressure gauges are not acceptable. Use a highest tensile indicating dynamometer. The dynamometer shall be used while pulling the cables to indicate the pulling tension on the cable and shall have a maximum tensile indicator which shall be sealed to prevent resetting. When more than one cable pull is to be made, a record shall be made and the dynamometer may be reset in the presence of the Owner's Representative who shall sign the recorded values of each pull. Pulling tension at no time shall exceed the manufacturer's recommendations. Replace cables that exceed the manufacturer's recommended pulling tensions during installation.

- K. The length of cable left in manholes shall be sufficient to allow for racking the cable the long way around, testing and splicing. All splices shall be located between cable supports. Cables shall be offset when entering manholes so that when cable is racked in place in the manhole the cable is able to move in and out of the manhole, at the bell, due to contraction and expansion. Cables shall be trained in manholes and supported from cable racks.

3.11 PHASING AND COLOR CODING

- A. The insulation or covering of each wire or cable shall be color coded so as to provide for circuit identification as specified below.

120/208 Volt	Phase
Black	A
Red	B
Blue	C
White	Neutral
Green	Ground

Where multiple neutrals are installed in the same conduit they shall be identified at all visible locations, by a 1/2" wide colored tape wrapped around the conductor that matches the color coding of the associated phase conductor, to ensure that the correct conductor associations are maintained. The color tape shall not obscure the fact that this is a neutral conductor.

- B. Color coding shall be achieved by one of the following methods:
1. The insulation or covering shall be coded during manufacture by use of one of the following methods:
 - a. Color compounds.
 - b. Colored coatings.
 2. When limited quantities of cable are involved, the Architect may permit the use of the following methods in lieu of cable manufacturer's color coding. Each cable must be coded at all terminal points, in all manholes, boxes, or other similar enclosures by:
 - a. Spiral application of 3/4" wide, colored, pressure sensitive plastic tape, half-lapped for a distance of not less than 6" (152mm). To prevent unwinding, the last two wraps of tape shall be applied with no tension. The tape shall be applied so as not to obliterate identification markings on the cable.
 - b. Application of three 3/16" wide colored, fungus inert, self-extinguishing, self-locking, nylon cable ties spaced 3" apart. The ties shall be snugly applied with a special tool or pliers, and any excess removed.
- C. The same colored cable shall be connected to the same phase throughout the project.
- D. In general, building load centers and panelboards shall be phased "A", "B", "C", either top to bottom or left to right when viewed from front of equipment. The neutral, although it may be in different locations for different equipment, shall be identified.

- E. Installer shall be responsible to coordinate electrical phases "A", "B", "C", with the Utility Company at the point of connection with the Utility Company supply and shall thereafter be responsible to carry out and maintain this consistent system of color coding, phase identification and positioning in accordance with ANSI Standards.

3.12 TELECOMMUNICATIONS RACEWAYS

- A. Raceways installed for Telecommunications Systems including telephone, data, security, alarm, CATV, sound, video, low voltage conductors, etc. shall be installed as required by the Electrical Code, as required for raceways specified in this Section and as indicated herein.
- B. Provide pull boxes each time raceway installation exceeds a 100' section or a total of 180° in bends and offsets between pull boxes. Do not install a pull box in lieu of a conduit bend. Align the corresponding conduits on opposite sides of pull box with each other.
- C. Bends shall be large radius, not exceeding 90° and minimum size radius as follows:
 - 1. 2" trade size and less - 6 times conduit diameter.
 - 2. 2-½" trade size and larger - 10 times conduit diameter.
 - 3. Conduits for fiber optics cabling - 10 times conduit diameter.
- D. Raceways and outlets shall be separated from sources of EMI and RFI such as transformers, ballasts and power lines. Do not install raceways parallel to power raceways unless 4' distance is maintained. Cross other raceways at 90 degrees. Maintain minimum 12" clearance in all directions from lighting fixtures and power wiring rated over 20 A. Maintain a minimum 6" clearance elsewhere from raceways and outlets. Maintain 48" clearance from transformers. Clearances are measured all around raceway and outlets including through walls and floors.
- E. Provide conduit sleeves between stacked Telecommunication closets or rooms.
- F. Align sleeves and conduits on opposite walls so there is a straight line, parallel or perpendicular to Building Structure, between corresponding openings.

3.13 MOUNTING HEIGHTS AND SPECIAL REQUIREMENTS

- A. Electrical equipment with the exception of those items listed below shall be mounted at heights as detailed on the Architectural Drawings. Notes or details on the Architectural Drawings pertaining to mounting heights or locations of electrical equipment shall supersede those noted or detailed on the Electrical Drawings. For the following equipment, the contractor shall identify in writing any discrepancy between the locations indicated on the electrical plans with locations identified on the architectural drawings and seek the direction of the architect. This equipment includes:
 - 1. Fire alarm, emergency lighting, and any other life safety systems, the electrical drawings and specifications shall take precedence. Bring any conflicts to the attention of Architect and Engineer prior to rough-in. If the mounting height of any electrical component is questionable, obtain a clarification from the Architect before installation. Locate devices with respect to masonry joints. Line up with joints and adjust height given below respecting minimum and maximum heights. Install devices plumb and level.
- B. Receptacles shall be mounted vertically with the grounding posts at the top of the device. Where receptacle are indicated to be horizontal, mount with the ground post to the right with the neutral connection at the top. 20A, 125V receptacles shall be side wired utilizing side screw terminals.

- C. Reflected Ceiling Plans for any and all areas prepared by the Architect showing the location of lighting fixtures shall take precedence over the locations of same indicated on the Electrical Lighting Drawings. Install the lighting fixtures in any given area to agree with the Architect's Reflected Ceiling Plans.
- D. Seal openings made in construction separating conditioned and non-conditioned spaces or spaces conditioned to different requirements (e.g. air conditioned versus non-air conditioned, heated versus non-heated, refrigerated versus non-refrigerated, etc.). Provide gasket, caulk, weatherstrip, or otherwise seal to prevent air infiltration. Raceways shall also be sealed and provided with fittings to allow drainage of moisture. Outlet plate gaskets shall be installed on all receptacles, switches, and other electrical boxes.
- E. Provide equipment rated (30mA GFI) GFCI protection on all heat tracing circuits.
- F. Circuits on panelboards shall be field connected to result in evenly balanced loads on each phase. Review items which are installed in large quantities to ensure single phase taps in three phase loads (for example, fan powered boxes with heating elements) are evenly distributed over all phases.
- G. The panelboard circuit numbering system is for outlet grouping purposes only and the final circuit identification shall be by the Installer. Panelboard phase loading shall be balanced by the Installer.
- H. On finished walls, switches shall be flush-mounted. Where two or more switches are indicated at one location, they shall be installed under a common wall plate. All switches shall be mounted approximately 4' (1.2m) above the floor and shall be located on the knob side of all doors. In masonry construction line up edge of switch boxes with masonry joints.
- I. Occupancy sensors shall not be located closer than 4' (1.2m) from HVAC diffusers.

3.14 MOTORS AND CONTROLS

- A. Disconnect switches, except as part of packaged units, shall be provided under this Section.
- B. Manual motor starters shall be push-button or toggle operated with thermal overload protection in each phase and mounted in a NEMA 1 enclosure.
- C. Each motor shall be provided with a disconnecting means under this Section of the specifications where required by the Electrical Code. A circuit breaker or horsepower rated switch in a panelboard shall be acceptable as a disconnecting means if located within sight of the motor controller or provided with locking device. For single-phase motors, a single or double pole tumbler or snap switch, rated only for alternating current, shall be acceptable for capacities less than 30 amperes, provided that the ampere rating of the switch is at least 125 percent of the rating of the controlled equipment. Switches shall be horsepower rated and shall disconnect all ungrounded conductors.
- D. Each motor controller and disconnect switch or separately enclosed circuit breaker shall be identified as to the equipment which it serves.
- E. Motor starters shall be mounted on new ¾" (19mm) exterior grade plywood mounting board. These shall be mounted at 60" (1524mm) above finished floor on solid walls or columns in spaces not normally occupied. Obtain approval of starter locations from the Architect.

- F. Carefully check electrical connections and sizing of motor circuit protection and prevent damage to motors and equipment due to incorrect direction of rotation caused by faulty electrical connections or incorrectly sized circuit protection. Pay all costs associated with damage due to incorrect rotation, connection, or circuit overload protection.

3.15 LIGHTING

- A. Emergency Battery System Instrumentation and controls shall be suitable to determine that the system is operating in a satisfactory manner. As a minimum these shall include light, battery voltmeter and ammeter, AC voltmeter, and test switch to check entire System operation.
- B. Where a lighting fixture is scheduled with a remote LED driver, the driver location requirements shall be as follows:
 - 1. Remote LED drivers for lighting fixtures serving the bedrooms shall be located on the wall above the accessible suspended ceiling outside the specific bedroom.
 - 2. Remote LED drivers for all other indoor lighting fixtures shall be located wall mounted above the nearest accessible suspended ceiling space to the specific lighting fixture for that driver.
 - 3. Remote LED drivers for exterior building mounted lighting fixtures shall be located wall mounted above the nearest interior accessible suspended ceiling space to the specific lighting fixture for that driver.
 - 4. Remote LED drivers for exterior lighting fixtures that are located in/at grade, on poles, at/in benches, and walls or other structures not adjacent to the building interior shall be located in the nearest site lighting handhole to that lighting fixture. Provide additional handholes to those indicated for drivers. Carry in bid all costs for complete installations.
- C. Prior to installation of remote LED drivers coordinate exact locations with the architect, and confirm all driver and lighting fixture manufacturers requirements for installation.
- D. Remote LED drivers installed indoors shall be installed in steel boxes with louvered screw fastened steel covers. Boxes shall be custom sized for air circulation for the drivers.
- E. All low voltage wiring shall be installed in conduits meeting all requirements of the specifications and the drawings for the specific applications.
- F. Suspended fixtures shall be supported from aircraft cable (where indicated) or from not less than 1/2", pendant stem or conduit mounted, with Seismic ball-aligned, or swivel hangers to assure plumb alignment.
- G. Fixtures shall be supported from the structural members, independent of furred or suspended ceilings or roof deck, using beam clamps or concrete inserts. Provide threaded rod supports unless otherwise indicated. Jack chain rated at three times fixture weight may be used above accessible ceilings. Support rectangular fixtures at each corner for four connections to fixture and provide a common vertical connection to structure, typical at both ends. This support shall be in addition to regular fixture support bars, saddles, etc. Where ductwork, pipes, type of building construction materials and structural framing members provide obstruction or difficult support means, hanger rods

shall be used in association with horizontal sections of steel support channels, in an approved manner. Fixture supports shall be installed taut so as not to put additional weight on ceiling.

- H. Consult with the Ceiling Contractors and coordinate fixture locations and supports with the suspended ceiling system. Do not support fixtures from ceiling.
- I. All wiring for the emergency lighting and exit signs shall be installed in conduits and shall be kept independent of all other normal system branch wiring. All DC wiring shall be #10 AWG minimum.

3.16 SURGE PROTECTION DEVICES (SPD)

A. Factory Testing

- 1. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, IEEE, and UL standards.

B. Warranty

- 1. The manufacturer shall provide a ten (10) year warranty (15-year warranty with registration) that covers replacement of the complete unit, including lightning, from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.

C. Application

- 1. Provide SPD protection levels as indicated herein. Provide for equipment as indicated herein or on the Drawings.
- 2. As a minimum provide SPD protection for the following:
 - a. Main Service Equipment.

D. Installation of Suppression/Filter Devices

- 1. Coordinate voltage, wiring configuration and short circuit (AIC) rating of device with load and building distribution system characteristics prior to installation.
- 2. In all instances observe manufacturer's recommendations for installation of all devices.
- 3. Connect the SPD in parallel to the power source, keeping conductors as short and straight as possible. Wire length shall not exceed 3' (1m) in length. Twist the SPD input conductors together to input conductor inductance. When installed adjacent to an electrical panelboard, the unit shall be close nipped to the panel and be supplied by a 30-amp circuit breaker with #10 AWG conductors.
- 4. For wiring up to 150 A device rating, provide Kelvin type wiring connections, which consist of wiring from the overcurrent device to double lugs on the SPD and from the SPD to the load. Higher ampacity circuits or at service entrances, provide standard parallel wiring.
- 5. Install on vibration isolation pad.

E. General Wiring Tests

1. Prior to energizing the suppression/ filter system verify the following:
 - a. System voltage and frequency are correct.
 - b. Devices are properly rated for loads being served.

F. Factory Start-Up of Suppression/Filter Systems

1. Retain the services of a certified factory representative to perform final field observations of each device installed with a test set to ensure that the devices are operating within factory specified tolerances.
2. Upon completion of field observations, provide a letter from the factory representative stating that installation has been reviewed for conformance with the installation instructions.

G. Owner Training

1. Provide 4 hours of instruction to Owner regarding operation, maintenance, and testing procedures. Include instruction on proper operation of Diagnostic Test Set if provided.
2. Provide nameplate adjacent to SPD indicating "SPD - CALL FOR SERVICE IF LIGHT IS OFF. PROPER OPERATION OF THIS UNIT IS VITAL FOR PROTECTION OF ELECTRONIC EQUIPMENT."

3.17 TESTING AND INSPECTION

- A. Provide labor, installation, supervision, test equipment, material, power supplies, devices, etc. required to perform the work indicated.
- B. Test and inspect all parts of the work provided under this Section and as required by Manufacturers, codes, standards, or authorities having jurisdiction. Conduct all tests and inspections to the complete satisfaction of the Architect and all authorities. Tests shall be completed and Electrical work 100 percent operational including any interfaces with other systems prior to performing Acceptance Demonstrations. Notify the Architect, the Owner via General Contractor, and all involved authorities at least one week (seven days) prior to testing or inspection. Do not cover work prior to testing or inspection. Testing shall be completed prior to Substantial Completion.
- C. Prior to the date of Substantial Completion and Acceptance Demonstrations, furnish the Architect with certificates of testing and inspection for all systems furnished or installed under this Section indicating the approval of all authorities having jurisdiction, manufacturers and a letter from the installer stating conformance with all requirements of the Contract Documents.
 1. Affidavits
 - a. Final affidavits will be signed by the engineer only after all specified systems are complete, tested and accepted and all documentation is submitted and approved as defined in the Building Code: the applicable Referenced Standards; this Section 26 10 00; Section 20 50 00; and the Project Fire Protection Narrative filed with the permit documents.

- D. All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than the values recommended by the manufacturers.
- E. Test all circuits and receptacles for proper neutral and grounding connections.
- F. Lighting fixtures shall be tested with specified lamps in place for not less than ten hours; the fixtures may be checked in sections.
- G. Testing recommended by manufacturers shall be required; this requirement may be waived in writing by the Architect.
- H. Failure or defects in workmanship or materials revealed by tests or inspection shall be corrected promptly and retested. Defective material shall be replaced at no additional expense to the Owner.
- I. Provide all temporary connections, necessary testing equipment, labor and materials, required for the testing of the systems and equipment. All systems shall be prepared for testing and protected from damage. The cost of all tests shall be included in the contract price.
- J. Verify and correct as necessary the following: voltages, tap settings, trip settings, and phasing on all equipment and devices furnished or installed. Secondary voltages shall be tested at the bus in the main switchboard, at panelboards, and at such other locations on the distribution systems as necessary. Secondary voltages shall be tested under no-load and full-load conditions.
- K. Electronic solid state trip units shall be set by a manufacturer's trained technician as follows:
 - 1. All circuit breakers with solid state trip units shall be initially pre-set to the equivalent LT, LTD, ST, STD setting of the thermal magnetic version of the same ampere rated circuit breaker. Instantaneous setting shall be not less than 4X.
- L. Measure minimum and maximum voltages and voltage between phase wires and neutral, and immediately deliver a report on all voltage measurements to the Architect.
- M. Test systems installed for proper operation and adherence to specifications.
- N. The equipment grounding shall be checked to insure continuity of the ground return path.
- O. Test the generator in the presence of the local Inspector.
- P. Provide a written report on all testing and device settings. Include a copy in the Operation and Maintenance Manual.
- Q. Adjust occupancy, vacancy sensors and photo sensors for proper operation including time delay, sensitivity, field of view (masking), typed sensing and parallel operation.

3.18 ACCEPTANCE DEMONSTRATIONS

- A. Systems installed under this Section shall be demonstrated to the Owner, Architect and Engineer. Demonstrations are in addition to necessary testing and training sessions. Notify all parties at least 7 days prior to the scheduled demonstration. Schedule demonstrations in cooperation with and at times convenient to all parties and so as to not disturb ongoing activities.

- B. Systems shall be tested prior to the demonstrations and each system shall be fully operational and tested prior to arranging the Acceptance Demonstration. Final payments shall be withheld until a satisfactory demonstration is provided for all systems indicated or requested.
- C. If the demonstration is not totally complete, performing all functions, features and connections or interfaces with other systems, or if there is a failure during the demonstration, additional demonstrations shall be arranged. Provide and pay for all costs, labor and expenses incurred for all attendees for each additional demonstration required for acceptance and demonstration of complete system operation.
- D. Demonstrations shall be scheduled in ample time to complete all activities prior to final acceptance and Owner occupancy. Demonstrations shall take place at least 30 days prior to the scheduled project completion date and 30 days prior to Owner's use and occupancy.
- E. As a minimum, provide demonstrations for systems indicated under "Work Included" under Part One of the Specifications. Provide demonstrations of additional systems as requested by the Owner, Architect, or Engineer.

3.19 COOPERATION AND WORK PROGRESS

- A. The Electrical work shall be carried on under the usual construction conditions, in conjunction with all other work at the site. The Electrical Subcontractor shall cooperate with the Architect, General Contractor, all other Subcontractors and equipment suppliers working at the site. The Electrical Subcontractor shall coordinate the work and proceed in a manner so as not to delay the progress of the project.
- B. The Electrical Subcontractor shall coordinate his work with the progress of the building and other Trades so that he will complete his work as soon as conditions permit and such that interruptions of the building functions will be at a minimum. Any overtime hours worked or additional costs incurred due to lack of or improper coordination with other Trades or the Owner by the Electrical Subcontractor, shall be assumed by him without any additional cost to the Owner.
- C. The Electrical Subcontractor shall furnish information on all equipment that is furnished under this Section but installed under another Section to the installing Subcontractor as specified herein.
- D. The Electrical Subcontractor shall provide all materials, equipment and workmanship to provide for adequate protection of all electrical equipment during the course of construction of the project. This shall also include protection from moisture and all foreign matter. The Electrical Subcontractor shall also be responsible for damage which he causes to the work of other Trades, and he shall remedy such injury at his own expense.
- E. Waste materials shall be removed promptly from the premises. All material and equipment stored on the premises shall be kept in a neat and orderly fashion. Material or equipment shall not be stored where exposed to the weather. The Electrical Subcontractor shall be responsible for the security, safekeeping and damages, including acts of vandalism, of all material and equipment stored at the job site.
- F. The Electrical Subcontractor shall be responsible for unloading all electrical equipment and materials delivered to the site. This shall also include all large and heavy items or equipment which require hoisting. Consult with the General Contractor for hoisting/crane requirements. During construction of the building, the Electrical Subcontractor shall provide additional protection against moisture, dust accumulation and physical damage of the main service and distribution equipment. This shall include furnishing and installing

temporary heaters within these units, as approved, to evaporate excessive moisture and ventilate it from the room, as may be required.

- G. It shall be the responsibility of the Electrical Subcontractor to coordinate the delivery of the electrical equipment to the project prior to the time installation of equipment will be required; but he shall also make sure such equipment is not delivered too far in advance of such required installation, to ensure that possible damage and deterioration of such equipment will not occur. Such equipment stored for an excessively long period of time (as determined in the opinion of the Architect) on the project site prior to installation may be subject to rejection by the Architect.
- H. The Electrical Subcontractor shall erect and maintain, at all times, necessary safeguards for the protection of life and property of the Owner, Workmen, Staff and the Public.
- I. Prior to installation, the Electrical Subcontractor has the responsibility to coordinate the exact mounting arrangement and location of electrical equipment to allow proper space requirements as indicated in the NEC. Particular attention shall be given in the field to group installations. If it is questionable that sufficient space, conflict with the work of other Subcontractors, architectural or structural obstructions will result in an arrangement which will prevent proper access, operation or maintenance of the indicated equipment, the Electrical Subcontractor shall immediately notify the Contractor and not proceed with this part of the Contract work until definite instructions have been given to him by the Architect.

3.20 INSTALLATION

A. General

- 1. Unless specifically noted or indicated otherwise, all equipment and material specified in Part 2 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes or material and equipment.
- 2. The Electrical Subcontractor shall obtain detailed information from manufacturers of equipment provided under Part 2 of this specification as to proper methods of installation.
- 3. The Electrical Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or furnished by the Owner.
- 4. The Electrical Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.
- 5. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.
- 6. Throughout this Section where reference is made to steel channel supports, it shall be understood to mean that the minimum size shall be 1 5/8" mild strip steel with minimum wall thickness of 0.105", similar to Unistrut P1000 or equal products manufactured by Kindorf or Husky Products Co. Where reference to channel supports is made under "Lighting Fixtures" paragraph of this Section, the maximum length of span shall be 10'-0". If longer spans are required, the size

and wall thickness of the steel channel support shall be as specifically approved by the Engineer.

B. Electrical Distribution Equipment

1. The Electrical Subcontractor shall install all emergency electrical distribution equipment per the manufacturer's recommendations and the Contract Drawings.
2. The installation of all equipment, including working space requirements, shall conform to all NEC and local codes.
3. All necessary hardware to secure the assembly in place shall be provided by the Electrical Subcontractor.
4. The Electrical Subcontractor shall ensure that no piping, ductwork or other equipment foreign to the electrical trade passes through the area extending from the floor to the structural ceiling with the width and depth equal to that of the electrical distribution equipment plus 6" on either side of panel.
5. Floor mounted assemblies shall be installed on concrete housekeeping pads and shall be provided with adequate lifting means. Floor mounted assemblies shall be capable of being moved into installation position and bolted directly to **the floor without the use of floor sills. The Electrical Subcontractor shall ensure the floor is level to 1/8 inch per 3-foot distance in any direction. Electrical Subcontractor supplied floor sills to be set level in concrete per manufacturer's recommendations.**
6. All floor and wall mounted electrical equipment shall be installed such that the handle of the highest circuit breaker does not exceed 6'-6" above finished floor.
7. The equipment shall be installed and checked in accordance with the manufacturer's recommendations prior to first energization. This shall include but not limited to:
 - a. Checking to ensure that the pad location is level to within .125 inches.
 - b. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
 - c. Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
 - d. Secure assemblies to foundation or floor channels.
 - e. Measure and record megger readings phase-to-phase, phase-to-ground, and neutral-to-ground (four-wire systems only).
 - f. Inspect and install all circuit breakers, components, etc. in their proper compartments.
8. Identification shall be provided for all electrical distribution equipment. The electrical system identification shall clearly describe the equipment connected. Method of identification shall be by laminated nameplate made of bakelite or similar material with engraved letters at least 1/4" high and securely attached to the equipment with galvanized screws. Adhesives or cements shall not be used. A list of nameplates shall be submitted to the Architect for approval prior to fabrication.
9. Control wiring shall be provided as required. Interface all local and remote control wiring and operational systems for each load.

3.21 MATERIALS AND WORKMANSHIP

- A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.
- B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.
- C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.
- D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.
- E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.
- F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

3.22 TRAINING

- A. The Electrical Subcontractor shall provide a training session for up to **2** Owner's representative for **2** normal workdays at a jobsite location determined by the owner.
- B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.
- C. The training program shall include the following:
 - 1. Review of the project one-line drawings and schedules.
 - 2. Review of the factory record shop drawings.
 - 3. Review of all equipment in the emergency electrical distribution system.
 - 4. Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.
 - 5. Provide three ring binders to participants complete with copies of drawings and other course material covered.

3.23 OPERATION INSTRUCTIONS AND MAINTENANCE MANUALS

- A. After completion of work and start-up of the equipment at the jobsite, deliver to the Contracting Officer, copies of operating instructions, maintenance manuals and drawings presenting full details for care and maintenance of each item of equipment furnished and/or installed under this Contract.

- B. Each manual shall contain the operating and maintenance information and parts lists furnished by the manufacturer, for all equipment provided in the Contract. When necessary, provide supplemental drawing to show system operation and servicing and maintenance points. For all electrical components, furnish wiring and connection diagrams. Manuals shall include instructions required to accomplish specified operation and functions. Data shall be neat, clean, legible copies. Drawings shall be accordion folded. Non-applicable information shall not be included. Five (5) sets of manuals shall be furnished to the Owner.

END OF SECTION

SECTION 283000 - FIRE ALARM SYSTEM FOR LOW RISE BUILDINGS

TABLE OF CONTENTS

PART 1 - GENERAL	1
1.1 SUMMARY	1
1.2 CODES AND STANDARDS	2
1.3 QUALITY ASSURANCE.....	3
1.4 SUBMITTALS	3
1.5 RELATED DOCUMENTS	5
1.6 AS-BUILT DRAWINGS AND OPERATING AND MAINTENANCE INSTRUCTIONS.....	5
PART 2 - PRODUCTS	6
2.1 IDENTIFICATION	6
2.2 FIRE ALARM SYSTEM - EXTENSION.....	6
PART 3 - EXECUTION	10
3.1 REFERENCE	10
3.2 SPECIAL RESPONSIBILITIES	10
3.3 FIRE ALARM DEMOLITION AND RENOVATION WORK	10
3.4 GROUNDING	12
3.5 SLEEVING AND BUSHINGS	12
3.6 MOUNTING HEIGHTS AND SPECIAL REQUIREMENTS	12
3.7 FIRE ALARM SYSTEM	12
3.8 TESTING	14

SECTION 283000 - FIRE ALARM SYSTEM FOR LOW RISE BUILDINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of this Section is governed by the General Conditions, Supplementary Conditions, Sections in Division 1, Section 20 05 00, and Section 20 05 48 of the Project Manual.
- B. Perform work and provide materials and equipment as shown on Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide complete and fully functional systems' installation.
- C. Give notices, file plans, obtain permits and licenses, pay fees and backcharges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with the Contract Documents.
- D. UL Listing:
 - 1. Furnish UL listed and labeled equipment, devices, and materials. Where a UL listing is not available, submit the test reports of an independent testing engineer indicating that equipment is in conformance with local and state codes. Tests and inspections required for approval shall be performed at no additional cost to the Owner.
- E. In general, the work of this Section shall include, but not be limited to:
 - 1. Fire alarm control panel (work with existing).
 - 2. Manual pull stations.
 - 3. Smoke detectors.
 - 4. Heat detectors.
 - 5. Notification devices.
 - 6. Addressable interface.
 - 7. Protection of new and existing work.
 - 8. Record Drawings and Documentation.
 - 9. Staging.
 - 10. Seismic Supports, Supplementary Steel and Channels.
 - 11. Testing and certifications.
 - 12. Fireproofing of Penetrations and Openings.
 - 13. Access panels and doors.
 - 14. Phasing of work and maintenance of service, to existing and temporarily relocated items, as required to meet the project schedule, including premium time.
 - 15. Programming.
 - 16. Labeling.
 - 17. Testing.
 - 18. Costs associated with core drilling, cutting and patching using appropriate and trained tradesman approved by the General Contractor and Architect.
 - 19. Demolition.

20. Seals.

F. Related Sections

1. Section 26 10 00 Electrical for cables, conductors, conduits, boxes, supports and seals.

G. Related work specified in other Sections includes, but is not necessarily limited to:

1. Temporary Facilities and Controls: Temporary fire alarm for use during construction.
2. Structural Steel: Equipment supports.
3. Metal Fabrications: Structural supports necessary to distribute loading from equipment to roof or floor.
4. Painting: Except as specified herein.
5. Acoustical Ceilings: Removal of existing ceilings for new work under this Section.
6. Section 21 10 00 - Fire Protection: Tamper, flow, pressure, and PIV switches. Fire alarm modules and wiring and wiring between modules and fire protection equipment by Division 28.
7. Section 26 10 00 – Electrical.

H. Alternates: Refer to pertinent Sections of Division 1 for description of work under this Section affected by Alternates.

1.2 CODES AND STANDARDS

- A. The fire alarm system work shall comply with the applicable provisions of the following NFPA Standards: 72, 90A, 92A, and 101.
- B. All equipment, devices, cables, etc., shall be NRTL listed.
- C. The system shall comply with all state and local codes with no exception.
- D. The system shall comply with Local Fire Department Regulations and Requirements.
- E. Notification appliance types and placement shall comply with the requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG). It is the responsibility of the fire alarm vendor to ensure that the correct locations and types of audible/visual alarm devices are provided.
- F. The system shall comply with the applicable provisions of the following UL Standards and Classifications:
 1. #864 Control Units for Fire Protective Signaling Systems.
 2. #1971 Signaling Appliances for the Hearing Impaired.
 3. #1076 Proprietary Burglar Alarm Units and Systems.
 4. UOJZ Control Units System.
 5. UOXX Control Unit Accessories System.
 6. UOQY Emergency Communication and Related Equipment.
- G. National Fire Protection Association (NFPA).

1. No. 70 – National Electrical Code
2. No. 70E – Standard for Electrical Safety in the Workplace
3. No. 72 – National Fire Alarm Code
4. No. 90a – Installation of Air Conditioning and Ventilating Systems
5. No. 101 – Life Safety Code

H. Americans with Disabilities Act (ADA).

1.3 QUALITY ASSURANCE

- A. Qualifications: Use adequate numbers of skilled, licensed workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
1. The Installer (Firm and Employees) shall be experienced in the operations they are engaged to perform and have at least five years of continuous recent experience on similar projects. The Installer shall hold recent, up-to-date licenses, certifications, and training certificates in the area in which the project is located and for the equipment to be installed.
 2. Provide a full-time on-site foreman who personally has been certified as described above. Submit all documentation under this Section.
 3. Each Foreman and Installer working on this project shall be trained by the Manufacturer whose equipment is being provided on the project. The training shall consist of a minimum of proper installation techniques of their specific equipment in order to have a complete operating system meeting or exceeding the requirements as specified herein. Each Foreman and Installer working on this project shall have documentation from the manufacturer indicating that they have been adequately trained prior to the start of the project. Only Foremen and Installers who have been properly trained and documented by the manufacturer whose equipment is being provided on this project shall be allowed to install same.

1.4 SUBMITTALS

- A. Comply with the pertinent provision of Sections in Division 1.
- B. General requirements are as follows for extension of existing system:
1. System Shop Drawings and Product Data Submittals are required to be submitted for review and shall contain the following information (Shop Drawings that are submitted for review without all of this information shall not be considered and shall be rejected.):
 - a. A detailed list of each new piece of equipment with model numbers for each component.
 - b. Manufacturer's Product Data Specification Sheets on each item of equipment.

- c. The manufacturer shall develop an input/output matrix that contains the equipment as shown and described within in the area of work. The matrix shall be based on the sequence of operation within this specification and in conjunction with the fire protection narrative which is issued with the permit documents. This matrix shall be reviewed as part of the overall submittal package.
- d. A confirmation, on the manufacturer's letterhead, that the manufacturer's representative has reviewed the existing system and is providing all required components for a complete and operational system as indicated herein and on the Drawings, shall provide jobsite supervision during the installation of the system, perform the final testing of the system in conjunction with the Owner's Testing and Service Company, and instruct the operating personnel on the operation of the system.
- e. Detailed one-line schematic wiring diagrams of the system and its interconnecting wiring. Typical wiring diagram shall not be accepted. All data submitted shall be complete for all equipment and shall apply only to this specific project. All extraneous material shall be deleted.
- f. Provide floor plans with device locations, addresses and candela ratings.
- g. Provide updated battery calculations.
- h. Provide voltage drop calculations.
- C. Manufacturer's original catalog data and descriptive information shall be supplied for all major components of the equipment to be supplied.
- D. Supplier's qualifications indicating years in business, service policies, warranty definitions, and a list of five similar installations with contact names and numbers.
- E. Installer's qualifications indicating years in business, manufacturer's certifications, and prior experience with installations that include the type of equipment to be supplied.
- F. All pertinent information regarding the reliability and operation of the equipment to be supplied.
- G. Projected installation and final test/acceptance dates of the equipment to be supplied.
- H. Sufficient information shall be supplied so that the exact function of each installed device is known.
- I. Submittal Schedule: Prepare and submit product data shop drawings, Operations and Maintenance (O&M) manuals and perform training as indicated on the following schedule:

PRODUCTS	Product Data	Shop Dwgs	O&M Man.	Spare Parts List	Demonstration / Training
FIRE ALARM SYSTEM – EXTENSION	X	X	X	X	X

1.5 RELATED DOCUMENTS

- A. Secure permits and approvals prior to installation.
- B. Prior to commencement and after completion of work: notify authorities having jurisdiction, review plans and shop drawings with them and comply with their procedures and requirements.
- C. Submit a letter of approval of the installation before requesting acceptance of the system. Follow requirements of the local Authority.

1.6 AS-BUILT DRAWINGS AND OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Operating and instruction manuals shall be submitted prior to testing the system - five complete sets of operating and instruction manuals, three shall be delivered to the Architect upon completion, and one to the Fire Department prior to final acceptance.
- B. A complete set of reproducible as-built documentation, including two prints, showing installed wiring, color coding, and wire tag notifications for exact locations of installed equipment, specific interconnections between all equipment, and internal wiring of the equipment, shall be delivered to the Architect upon completion of the system. A copy of the as-built prints shall be submitted to the Fire Department for final acceptance. Provide one copy of as-built documents in Fire Department key repository or drawing cabinet. As-built documents shall incorporate all changes made during the project so that documentation matches actual installation.
- C. Complete, simple, comprehensive, step-by-step operating instructions giving recommended and required testing frequency of all equipment. Also, the methods for testing each individual piece of equipment and a complete troubleshooting manual explaining what might be wrong if a certain malfunction occurs. These instructions shall also explain how to test the primary internal parts of each piece of equipment and shall be included with the Operation and Maintenance Manuals.
- D. Operating and maintenance instructions which shall be complete, easy to read, understandable, and shall provide the following information:
 - 1. Instruction on the troubleshooting and replacement of all serviceable components of the system.
 - 2. Instructions on periodic cleaning and adjustment of equipment with a schedule of these functions.

3. A complete list of all equipment and components with information as to the address and phone number of both the local supplier and manufacturer of each item.
4. User operating instructions (including necessary responses to alarms) which shall be prominently displayed on the cabinet front or on a separate sheet located adjacent to the control unit in accordance with UL #864. Include an additional copy in the Fire Department key repository or drawing cabinet.

PART 2 - PRODUCTS

2.1 IDENTIFICATION

- A. All equipment and designated devices shall be properly identified by means of permanent, clear, and concise nameplates, tags, signs, or directories mechanically fastened or engraved on the item to be identified. Properly applied epoxy or super glue adhesive may be accepted for device and nameplates only, with prior written approval of the Architect. Embossed adhesive labels are not acceptable for any identification required by the Drawings or Specifications.
- B. Provide tags identifying each individual cable, wire, or group of wires comprising a circuit and terminal boxes through which such wires run and at the equipment at which they terminate. Tags shall be flameproof linen fiber or pressure sensitive type unless otherwise indicated.
- C. Provide mechanically fastened three ply black bake-lite nameplates with ¼" (6mm) high engraved white letters on the following equipment. Wording of the nameplates shall be in conformance with the respective schedules and notes on the Drawings.
 1. Fire Alarm Terminal Cabinets: Nameplates shall be provided on the exterior of each terminal cabinet door identifying the name. Nameplates shall read as indicated on the Drawings and shall be mounted on the exterior of the panel and terminal cabinet doors 1/3 of the way down from the top of same.
- D. The covers of boxes, fitting, and enclosures shall be marked by means of fluorescent paint so they shall be readily identified as a component of the following systems:
 1. Fire Alarm – Red.
- E. Labels and installation shall meet the requirements of ANSI/TIA/EIA 606 and 607.
- F. Provide additional warning signs, plaques, or directories as required by code, local authority, or as specified or indicated on the Drawings.
- G. Identification materials shall be as manufactured by Seton Nameplate Company or approved equal by Dennison Manufacturing Company or Markem Company.

2.2 FIRE ALARM SYSTEM - EXTENSION

- A. General: The present building is equipped with an existing fire alarm system: The fire alarm system shall be an extension of this system, integrated to provide a complete system.

1. Contact the manufacturer to determine type of system and equipment required to make the extensions required to provide a working system. Equipment shall include (but not be limited to): items shown on the drawings, items specified herein, and central control, power supplies, amplifiers and other equipment required to connect new devices to the existing system.
 2. Verify the existing system operation prior to starting work. Be responsible for system operation at the completion of work, and consult with manufacturer and the Service Company and carry the costs for a complete and operational system.
 3. Provide an addition to the existing closed circuit, electrically supervised, automatic and manual, local energy, auxiliary fire alarm system. The system shall be wired, connected, tested, and left in first class operating condition. The equipment and completed installation shall be in compliance with local and national codes, authorities having jurisdiction, and in accordance with applicable sections of the latest edition of NFPA 72 for Auxiliary fire alarm systems.
 4. All new equipment shall be provided by the original manufacturer for complete compatibility with the existing system and to provide one manufacturer with total responsibility for the entire system's operation, warranty, and maintenance. No other manufacturer shall be acceptable.
 5. All final connections, testing, and adjusting of the system shall be done under the direct supervision of the system supplier and the Owner's Testing and Service Company. After completion of the installation, a trained technician employed by the system supplier shall demonstrate the system to be satisfaction of the Owner's Representative and shall make all additional adjustments to the system operation as required by the Owner's Representative as a result of this demonstration. Pay costs for all services to be provided by Owner's Testing and Service Company.
 6. Warrant the new equipment to be free from defects in material and workmanship for one year. Within one year from date of installation repair or replace any or all part of the equipment found to be defective at no cost to the Owner.
 7. The testing company shall be certified by UL and approved and witnessed (as required) by the local fire department.
- B. Operation: Unless noted elsewhere, the fire alarm system shall operate as the existing system.
- C. Related Work:
1. Coordinate work in this Section with all related trades. Provide interface work as indicated and required for a fully functional system. Work or equipment in other Sections and related to the fire alarm and protective system shall include, but not be limited to:
 - a. Sprinkler waterflow, tamper, and supervisory switches shall be provided under Division 21, but wired and connected to the fire alarm system under this Section.

- b. Sprinkler System Devices: Coordinate the following work to ensure that the required installation and wiring of all waterflow pressure, PIV, and tamper switches is accomplished in a manner that shall result in a completely operable and tested sprinkler system. Each device shall be a separate and distinct monitor point as follows:
 - 1) Waterflow switches shall initiate the building alarm sequence.
 - 2) Pressure Switches shall activate a supervisory condition.
 - 3) Tamper switches shall activate a supervisory condition.
 - 4) Post Indicator Valves (PIV) shall activate a supervisory condition.

D. Equipment:

- 1. Fire Alarm Control Panel:
 - a. Modify the existing fire alarm control panel to provide for proper system operation from both new and existing devices. Provide new power supplies, control modules, amplifier modules, and other equipment required for a complete system, **incorporated in surface mounted cabinets, with 200% extra cabinet capacity for future system expansion capability.** All control modules shall be labeled, all zone locations shall be identified, and the panel shall be provided with a set of permanently mounted operating instructions.
 - b. Reprogram the existing fire alarm control panel and annunciators as required to incorporate new fire alarm devices.
- 2. Remote Annunciators: Modify the existing annunciators to provide capacity for the new fire alarm zones and provide additional modules for zone annunciation to match existing.
- 3. Manual fire alarm stations matching the base building, shall be furnished where shown on Plans. A downward pull of the lever shall actuate a positive snap action switch. Station shall remain actuated until the station is reset by means of a key to be furnished with each station.
- 4. Heat Detectors: Provide the following (low profile, matte white): 135°F rate-of-rise fixed temperature type and 197°F fixed temperature types required by detector location (boiler room).
- 5. Smoke Detectors: Provide, where indicated on the Drawings, smoke detectors. Detectors shall be of the solid-state photoelectric type and shall operate on the light scattering, photodiode principle. Detectors shall be factory set to detect smoke at a nominal 2.5% light obscuration per foot regardless of the rate of combustion, the distance between the detector and the fire source, the combustible material, the temperature of velocity of the smoke, or whether the fire is in a confined or open area. To minimize nuisance alarms, detectors shall be designed to ignore invisible airborne particles or smoke densities that are below the factory set alarm point. No radioactive material shall be used.

- a. All smoke detectors shall be equipped with self-compensating circuitry to provide maximum stability against effects of aging, dust, and film accumulation. The detector light source shall be an LED. The detector shall be equipped with a pulsed LED power supervisory indicator. The detector shall be designed to latch into alarm following a short signal processing delay verifying the continued presence of smoke within the sensing chamber. An alarm condition shall be indicated by a steady red glow from the LED indicator. Remote LED alarm indicators shall be connected to detectors where shown on the Plans.
 - b. Smoke detectors shall have an integral fixed temperature heat detector rated at 135°F (57.2°C). The heat detector shall operate the alarm circuit and illuminate the smoke detectors "Alarm" LED (typically in dorms). Confirm if required.
 - c. A calibrated feature shall be provided which is capable of simulating a maximum acceptable amount of smoke for alarm. The test feature shall provide individual local testing of the detector and shall not require generation of actual smoke within the building. For ease of maintenance and installation, detectors shall be designed for twist lock mounting to a separate base assembly having screw terminals for external wire connections.
6. Primary Notification Appliances: Provide combination Audio/Visual signaling appliances to match those of the existing building. Stand-alone devices may be used to augment combination units where shown or required. The contractor shall provide surface mounted backboxes where required. Provide synchronized flashing xenon strobes in compliance with the Americans with Disabilities Act Applications Guidelines (ADAAG). Visual signals shall have a minimum effective intensity rating of 15 candela and be field selectable multi-criteria (15cd thru 185cd) candela as required by NFPA 72. Strobes shall produce a minimum of one and a maximum of three flashes per second across the listed voltage range.
7. Addressable Input Module: Provide single or dual addressable Input Modules to connect supervised conventional initiating devices onto the addressable loop.
8. Addressable Control Module: Provide Control Modules where required, to supervise and control conventional devices (Horns, Strobes, Boosters, Beacons, Bells, etc.) over the addressable loop. The module shall provide a supervised output rated for up to 3A @ 24VDC.
9. Addressable Relay Module: Provide Relay Modules where required, to supervise and control conventional devices (indicating, air handling, door holder, etc.) over the addressable loop. The module shall provide dual Form-C contacts rated at 3A @ 30VDC or .5A (pilot duty) @ 120VAC. When load exceeds limit of contacts, isolated power relays shall be used to extend the capacity of the contacts to support the load.

PART 3 - EXECUTION**3.1 REFERENCE**

- A. Refer to Section 26 10 00, Electrical.

3.2 SPECIAL RESPONSIBILITIES

- A. Do not install equipment and materials, which have not been reviewed by the Architect. Equipment and materials, which are installed without the Architect's review or without complying to comments issued with the review, shall be removed from the project when so instructed by the Architect. No payment shall be made for the removal of unapproved materials or equipment if it is ordered removed. The Installer shall be responsible for any ancillary costs incurred because of its removal and the installation of the correct equipment and materials.
- B. Obtain detailed information on installation requirements from the manufacturers of all equipment to be furnished, installed, or provided. At the start of construction, check all Contract Documents, including all Drawings and all Sections of the specifications for equipment requiring electrical connections and service.
- C. Equipment and systems shall not be installed without first coordinating the location and installation of equipment and systems with the Architectural drawings, General Contractor and all other Trades. Any and all material installed or work performed in violation of above requirements shall be re-adjusted and corrected by the Installer without charge.
- D. Assure that all equipment is accessible, such as junction boxes, pull boxes, relays, controls, and such other apparatus as may require maintenance and operation from time to time. Provide necessary construction access panels sized to provide adequate and required access for installation by the General Contractor. Provide rated panel or door appropriate for the construction being installed into fire, smoke and/or acoustical construction.
- E. After installation, equipment shall be protected to prevent damage during the construction period. Openings in conduits and boxes shall be closed to prevent the entrance of foreign materials.

3.3 FIRE ALARM DEMOLITION AND RENOVATION WORK

- A. Shut-off, disconnect, make safe and dismantle fire alarm systems to be demolished and leave fire alarm equipment and debris on floor for removal by the General Contractor. Disconnect existing fire alarm equipment to be demolished and identify items to be removed with orange spray paint for removal and disposal.
- B. Scope of demolition shall be as indicated on the design drawings and these specifications. Carefully examine the Drawings and visit the site to determine the extent of this work.
 - 1. Identify, prior to demolition and work beginning, fire alarm work that is to remain and that which is to be removed. Use spray paint color code that does not conflict with the color code indicated under "IDENTIFICATION" or color code used by existing, otherwise, tie colored ribbon in lieu of paint. Post color code in

- conspicuous area. The location of existing work is approximate. Determine exact location prior to performing work.
2. Equipment being demolished shall be disconnected and made safe.
 3. Fire alarm items that are to be relocated shall be carefully examined and checked for defects prior to removal. Defects shall be brought to the immediate attention of the Architect. After equipment has been certified to be in good condition, it shall be relocated and cleaned. Failure to identify, in writing, to the Architect defective existing work, indicates all existing is in good condition. Equipment damaged in this process shall be replaced with new equipment or repaired to the satisfaction of the Architect.
 4. Removed equipment, devices, and wire shall be offered to the Owner. Legally dispose of devices, equipment and material not retained by Owner.
 5. Maintain the existing building in fire alarm operation at all times during the entire construction period. If it is necessary to have a shutdown, a written request for approval shall be submitted in advance stating the estimated shutdown time. Work shall be planned to minimize shutdown. Shutdowns shall be at the convenience of the Owner and, if necessary, on premium time.
 6. Dispose of environmentally sensitive materials as required by the authority having jurisdiction.
- C. Existing cables run above ceiling, not run in metal raceway and not plenum rated, shall be disconnected, removed and replaced so as to be suitable for air handling plenums, per local, state, and national codes.
- D. The work of this Section includes being responsible for verifying the mechanical integrity of any existing raceway systems that are to be reused. Where the existing raceway system does not meet the requirements indicated in the electrical and fire alarm specifications, the raceway system shall be repaired or replaced before new wiring is installed.
- E. All existing exposed raceways and raceway components that are not to be reused shall be demolished. Where existing raceways are embedded in building construction, they shall be cut flush with finished surfaces and abandoned in place. All existing wiring shall be removed.
- F. It is imperative that a completely operable and operating fire detection and alarm system be maintained in all areas of the building where such protection is presently provided.
- G. The entire fire alarm system shall be maintained in full operable and operating condition until such time as the complete New Fire Detection, Communication and Evacuation System is installed and is operable.

3.4 GROUNDING

- A. Identify system components, wiring, cabling and terminals and provide grounding as per NFPA 72, the NEC and the system manufacturer.

3.5 SLEEVING AND BUSHINGS

- A. Raceways and openings shall be laid out in advance to permit their provision in the work. Sleeves and raceway shall be set before masonry is constructed. Any extra work, including coring, required where sleeves or raceways have been omitted or improperly placed shall be performed at the expense of the Installer who made the error or omission.
- B. Provide sleeves for raceways, fire walls, or smoke partitions. Install approved material to provide for fire stop.
- C. Provide waterproof seals inside and outside raceway when penetrating from the exterior.
- D. Provide acoustic sealer in sleeves between occupied spaces.

3.6 MOUNTING HEIGHTS AND SPECIAL REQUIREMENTS

- A. Fire alarm equipment with the exception of those items listed below shall be mounted at heights as detailed on the Architectural Drawings. Notes or details on the Architectural Drawings pertaining to mounting heights or locations of fire alarm equipment shall supersede those noted or detailed on the Electrical Drawings. For the following equipment, the contractor shall identify in writing any discrepancy between the locations indicated on the electrical plans with locations identified on the architectural drawings and seek the direction of the architect. This equipment includes:
 - 1. Fire alarm, emergency lighting, and any other life safety systems, the fire alarm and electrical drawings and specifications shall take precedence. Bring any conflicts to the attention of Architect and Engineer prior to rough-in. If the mounting height of any electrical component is questionable, obtain a clarification from the Architect before installation. Locate devices with respect to masonry joints. Line up with joints and adjust height given below respecting minimum and maximum heights. Install devices plumb and level.
- B. Seal openings made in construction separating conditioned and non-conditioned spaces or spaces conditioned to different requirements (e.g. air conditioned versus non-air conditioned, heated versus non-heated, refrigerated versus non-refrigerated, etc.). Provide gasket, caulk, weatherstrip, or otherwise seal to prevent air infiltration. Raceways shall also be sealed and provided with fittings to allow drainage of moisture. Outlet plate gaskets shall be installed on all receptacles, switches, and other electrical boxes.

3.7 FIRE ALARM SYSTEM

- A. Meet with the local fire department to coordinate with and provide all items required by the local fire department. Confirm location of outside beacon and operations with local fire department and pay all permit fees and backcharges.

B. General Fire Alarm Wiring:

1. All wiring for the system shall be in accordance with all code and local regulations including Articles 760, 725, and 800 of the Electrical Code.
2. Provide complete wiring and conduit between all equipment. All devices shall be mounted upon and terminations made in NRTL listed boxes. Wiring splices and transposing or changing of colors shall not be permitted.
3. Use 14 AWG minimum size solid conductors for fire alarm detection and signal circuit conductors unless otherwise required by the manufacturer. Use shielded wiring for initiating and communication (data and voice) circuits. Provide separate conduits or cables for trunks (communication between panels), signaling and initiating circuits.
4. Provide manufacturer-recommended cable for all initiating device and voice/data communicating circuits.
5. Terminate conductors using ring type compression connectors on labeled and numbered terminal blocks. Do not splice conductors, label conductors at all terminations with terminal number and system number.
6. Conductors for fire alarm shall be terminated only on terminal strips in junction boxes in cabinets, no splices or joints shall be allowed. Provide Sta-Kon or equal ring compression terminations.
7. Install fire alarm in True Red factory colored red conduit where exposed or subject to abuse. In building voids install cabling as follows:
 - a. Conduit, or in Fire Alarm low energy, red, plenum rated cables where approved in writing by local authority and the owner.

- C. Fire alarm junction boxes and terminal cabinets shall have a capacity forty percent greater than that required for the wiring and terminal blocks. Paint box or cabinet fire alarm red and identify with white lettering on the cover "FIRE ALARM SYSTEM". Indicate locations of terminal boxes and cabinets on Record Drawings.
- D. Fire Alarm control systems and equipment shall be connected to separate dedicated branch circuits, sized as required for proper service. Circuits shall be labeled 'FIRE ALARM'. Mount end of line devices in control panel or in terminal cabinets. Properly label and mount securely. Indicate locations of terminal boxes and cabinets on Record Drawings. Provide circuit breaker lock on devices for each circuit breaker.
- E. Make conduit and wiring connections to sprinkler flow switches, and sprinkler valve tamper switches.
- F. Automatic Detectors Installation: Conform to NFPA 72.
- G. Locate remote indicating pilot lights outside of room in normal view above door to isolated space, on ceiling or on wall at 6' above finished floor in locations approved by architect. Provide name plates on remote status lights and test stations.

- H. Install manual stations with operating handle 4' above floor. Manual stations shall be within 5'-0" of the exit door.
- I. Install audible and visual signal devices 6'-8" above the floor.
- J. Provide identification labels generated from a label-making machine for all fire alarm system devices (horns and strobes), remote test stations and remote alarm indicators. Include circuit designation and addresses for initiating devices circuits, circuit designations for notification devices, and designations of equipment and rooms served/located in for remote alarm indicators and remote test stations. Remote test stations for duct smoke detectors shall also designate unit and fan served.
- K. Audible devices shall be set for the following minimum dB levels:
 - 1. General Areas - 95dB at 10'.
 - 2. Small rooms (e.g. toilets, etc.) - 85 dB at 10'.
 - 3. Mechanical Rooms, Equipment Spaces - 100 dB at 10'.
 - 4. Set as required by the Fire Department.

3.8 TESTING

A. Manufacturer's Field Services:

- 1. Provide manufacturer certified and trained technicians and representatives for testing, supervision and assistance in the installation of the fire alarm system. Connections and terminations shall be made under the direct supervision of the fire alarm manufacturer. Equipment manufacturer shall be responsible for tests, programming, adjustment and calibration of the equipment.

B. Testing and Maintenance Agreement

- 1. Provide a one-year inspection and testing agreement in accordance with local Fire Department requirements and NFPA 72 recommendations. The holder of the testing and maintenance contract shall be a properly licensed and NRTL certified provider of Fire Alarm services and acceptable to the Fire Department.
- 2. Fire alarm testing agreement shall provide for a minimum of four inspections per year. Upon completion of each test, list actual devices checked. Provide a report to the Owner.
- 3. The testing and maintenance agreement contract shall provide at a minimum:
 - a. Four scheduled inspections and tests, free of charge for the first year.
 - b. Replacement of defective component parts (including batteries) at no cost.
 - c. Travel expenses and labor charge for emergency service calls.
 - d. Replacement of defective detectors discovered during tests.
 - e. Job site service to all components of the system.

- f. Correction of as-built drawings including point-by-point wiring diagram of the actual system, riser diagrams and device connection diagrams.
 - g. Additional training of Owner's personnel beyond the training provided by the Installer, in the response to various alarms and the operational and functional capacity of the system. Service personnel shall be trained by the equipment manufacturer.
 - 4. Provide response time of four hours maximum for any problem that prevents proper system operation, and a maximum 24 hour response for all other problems.
 - 5. Installer, Vendor/Supplier, and Manufacturer shall be available to assist the service company during the first year maintenance agreement.
- C. Acceptance Testing:
- 1. Pre-test the entire system and all functions to verify complete operation. After correct operation is verified, notify the Fire Department, Owner and the Architect that system is complete and ready for acceptance testing. Provide testing at a time mutually agreeable to all parties. Provide a minimum of one week notice.
 - 2. Testing shall be as required by the Fire Department, Local Authorities, the Owner and the Architect. At a minimum, operate every building fire alarm device to ensure proper operation, correct annunciation at each remote annunciator and control panel. One-half of all tests shall be performed on standby power. Where applying heat would destroy any detector, they may be manually operated. The initiating circuit and signaling circuits shall be opened in at least two locations per zone to check to the presence of correct supervisory circuitry.
 - 3. The entire fire alarm system shall be tested by smoke or heat activation of each device and system short circuiting at each remote test point of initiating zone and alarm circuits. Tests shall be performed in the presence of the Project Foreman, the Owner's representative, fire authority of the fire jurisdiction and the representative of the fire alarm system manufacturer.
 - 4. The entire system shall be marked per device circuit to indicate function and operation from manufacturer's point-to-point wiring diagrams. Drawings shall be signed by the Installer, Manufacturer and UL certified Testing Company and the Fire Department's Representative.
 - 5. Upon completion of testing, co-signed drawings and reports shall be forwarded to the Architect for record purposes for final acceptance. Testing and reports shall comply with NFPA 72 standard requirements.
 - 6. Provide testing by a UL certified testing company.
 - 7. Pay all costs for certification, testing and fire department approvals.
 - 8. Leave the fire alarm system in proper working condition.

9. Provide copies of testing reports and UL certification in the O & M manuals.

END OF SECTION