

SPOKANE
COMMUNITY
COLLEGE

December 23, 2019

Project Manual

SCC Lair Remodel

State Contract No. 2019-167 G (2-1)

Client Agency:
Community Colleges of Spokane

Contracting Agency:
Washington State
Department of Enterprise Services
Engineering & Architectural Services

Bid Set No.: _____

Prepared By:



203 N Washington, Suite 400 | Spokane, WA 99201
(509) 838-8568

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Community Colleges of Spokane
SCC Lair Remodel, Bld Set
Contract No. 2019-167 G (2-1)

TITLE SHEET

STATE CONTRACT NO: 2019-167 G (2-1)
STATE PROJECT NAME: SCC LAIR REMODEL
DATE: NOVEMBER 25, 2019
CLIENT AGENCY: COMMUNITY COLLEGES OF SPOKANE
CONTRACTING AGENCY: STATE OF WASHINGTON
DEPARTMENT OF ENTERPRISE SERVICES
ENGINEERING & ARCHITECTURAL SERVICES
A/E FIRM: ALSC ARCHITECTS, P S.
203 NORTH WASHINGTON, SUITE 400
SPOKANE WA 99201
509-838-8568

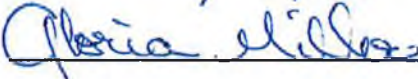
MECHANICAL AND ELECTRICAL ENGINEER
COFFMAN ENGINEERS
10 NORTH POST STEET, SUITE 500
SPOKANE WA 99201
509-328-2999

Client Agency:


Title: Director of Capital Construction

Date: 12/5/19

E & AS:


Title: Project Manager

Title: Project Manager

Date: 12-3-19

E & AS:


Title: Assistant Program Manager

Title: Assistant Program Manager

Date: 12/9/2019

ADVERTISEMENT FOR BIDS

Sealed bids will be accepted for the following project:

PROJECT NO.: 2019-167 G (2-1)

TITLE: SCC Lair Remodel, 2019

AGENCY: E&AS for Community Colleges of Spokane

PROJECT MANAGER: Gloria Miller

ESTIMATED BASE BID COST RANGE: \$622,250.00 to \$687,750.00

**SUBMITTAL TIME/DATE/LOCATION: Prior to 3:00 P.M., Tuesday, January 21, 2020
Community Colleges of Spokane
Esmeralda Center – District Facility Offices
3939 N. Freya, MS 1035
Spokane, WA 99217
Note: This is a new location for District Facilities
Offices. Offices are located in the northeast
corner of the Esmeralda Center. The entry door
is on the east wall farthest from Freya Street. If
locked, ring the doorbell or call (509) 389-5819.**

Public Bid Opening will commence at
approximately 3:05 P.M. at the same location.

BY: Department of Enterprise Services
Engineering & Architectural Services

PRE-BID WALK-THROUGH: 10:00 A.M., Tuesday, January 7, 2020. The Pre-Bid
Walk-Through shall be held on the campus of Spokane
Community College, 2000 N. Greene Street, Spokane,
WA, Max Snyder Building 50, Room 024. For
directions to the site of the pre-bid walk-through, please
contact the Consultant listed below.

Contractors may obtain plans and specifications Monday, December 23, 2019 at www.ALSCArchitectsPlanroom.com. Digital documents may be downloaded at no cost. Printed documents are available by choosing the “Order” option. General Contractors bidding as a Prime may obtain two (2) sets of plans and specifications upon receipt of a deposit check in the amount of \$100.00 made payable to ALSC Architects, P.S., and mailed to Abadan Reprographics, 603 E 2nd Avenue, Spokane, WA 99201, telephone (509) 747-2964. Plans must be returned in good condition within ten (10) days following bid date to obtain a refund of deposit. After seven days no refunds will be made.

Plans and specifications may be viewed at the following plan centers: Abadan Reprographics & Imaging, Spokane, WA; Associated Builders & Contractors, Spokane, WA; Associated General Contractors, Boise, ID; Builder's Exchange of Washington, Everett, WA; Daily Journal of Commerce Plan Center, Portland, OR; Daily Journal of Commerce, Seattle, WA; Hermiston Plan Center, Hermiston, OR; Contractor Plan Center, Milwaukie, OR; Ridgeline Graphics (Wenatchee Plan Center), Wenatchee, WA; Spokane Regional Plan Center, Spokane, WA; Tri-City Construction Council, Kennewick, WA; Walla Walla Valley Plan Center, Walla Walla, WA; Weekly Construction Reporter, Bellingham, WA; Yakima Plan Center, Yakima, WA.

Please direct questions regarding this project to the office of the Consultant, ALSC Architects, P.S., 203 N. Washington, Suite 400, Spokane, WA 99201, telephone (509) 838-8568, fax (509) 485-3710. Within 24 hours following the bid opening, results will be available on E&A Services' web site at <https://apps.des.wa.gov/EASbids/BidResult.aspx>.

The State of Washington prevailing wage rates are applicable for this public works project located in Spokane County. Bidders are responsible to verify and use the most recent prevailing wage rates. The "Effective Date" for this project is the Bid Form due date above. The applicable prevailing wage rates may be found on the Department of Labor & Industries website located at <https://fortress.wa.gov/lni/wagelookup/prvWagelookup.aspx>.

Supplemental Bidder Responsibility will be evaluated for this project. In determining Bidder responsibility, the Owner shall consider an overall accounting of the criteria set forth in "DIVISION 00 SUPPLEMENTAL RESPONSIBILITY CRITERIA". Please direct questions regarding this subject to the office of the Consultant.

The successful Bidder is required to register and create an account in the DES Diversity Compliance program (B2Gnow) at <https://des.diversitycompliance.com>. Voluntary numerical Diverse Business goals of 10% MBE, 6%, WBE, 5% Washington Small Business, and 5% Veterans have been established for this project. Achievement of the goals is encouraged.

Bidders may contact the Office of Minority and Women's Business Enterprise (OMWBE) at <http://OMWBE.wa.gov/> to obtain information on certified firms. Bidders may also utilize Washington Small Businesses registered in WEBS at <https://pr-webs-vendor.des.wa.gov/> and Veteran-owned Businesses at <http://www.dva.wa.gov/program/certified-veteran-and-servicemember-owned-businesses>.

The State reserves the right to accept or reject any or all bids and to waive informalities.

STATE OF WASHINGTON
DEPARTMENT OF ENTERPRISE SERVICES
ENGINEERING & ARCHITECTURAL SERVICES

2019167Gadvaf

Instructions to Bidders – July 1, 2019

General Conditions – July 2010

Annotated

Supplemental Conditions – June 1, 2018

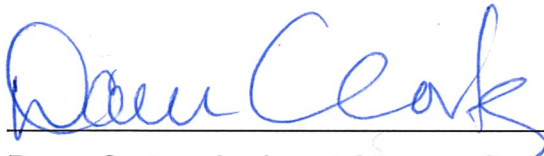
For Washington State Facility Construction

Effective: July 1, 2019

Approved by:



William J. Frare, Assistant Director
Facilities Professional Services



Dawn Cortez, Assistant Attorney General
Washington State Office of the Attorney General



Facility Professional Services, Engineering & Architectural Services
PO Box 41476
Olympia, Washington 98504-1476
(360) 902-7272

**INSTRUCTIONS TO BIDDERS
FOR WASHINGTON STATE FACILITIES CONSTRUCTION
July 1, 2019**

PART 0 – GENERAL CONDITIONS

0.00 EXPLANATION TO PROSPECTIVE BIDDERS

- A. In accordance with RCW [39.04.380](#) effective *March 30, 2012*, the State of Washington is enforcing a **Reciprocal Preference for Resident Contractors**. Any public works bid received from a nonresident contractor from a state that provides an in-state percentage bidding preference, a comparable percentage disadvantage must be applied to the bid of that nonresident contractor.

A nonresident contractor from a state that provides a percentage bid preference means a contractor that:

1. Is from a state that provides a percentage bid preference to its resident contractors bidding on public works contracts.
2. At the time of bidding on a public works project, does not have a physical office located in Washington.

The state of residence for a nonresident contractor is the state in which the contractor was incorporated or, if not a corporation, the state where the contractor's business entity was formed.

All nonresident contractors will be evaluated for out-of-state Bidder preference. If the state of the nonresident contractor provides an in-state contractor preference, a comparable percentage disadvantage will be applied to their bid prior to contract award.

This section does not apply to public works procured pursuant to RCW [39.04.155](#), [39.04.280](#), or any other procurement exempt from competitive bidding.

- B. Any prospective Bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must submit a request in writing to the Architect/Engineer (A/E) seven (7) calendar days before the bid due date. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective Bidder concerning a solicitation will be furnished promptly to all other prospective Bidders by addendum to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective Bidders.
- C. In accordance with the legislative findings and policies set forth in RCW [39.19](#) the State of Washington encourages participation in all of its contracts by MWBE firms certified by the Office of Minority and Women's Business Enterprises (OMWBE). Participation may be either on a direct basis in response to this invitation or as a subcontractor to a Bidder. However, unless required by federal statutes, regulations, grants, or contract terms referenced in the contract documents, no preference will be included in the evaluation of bids, no minimum level of MWBE participation shall be required as a condition for receiving an award, and bids will not be rejected or considered non-responsive on that basis. Any affirmative action requirements set forth in federal regulations or statutes included or referenced in the contract documents will apply.

- D. The State of Washington encourages participation in all of its contracts by Veteran-owned businesses (defined in RCW [43.60.010](#)) and located at <http://www.dva.wa.gov/program/certified-veteran-and-servicemember-owned-businesses> and Small, Mini and Micro businesses (defined in RCW [39.26.010](#)) which have registered in WEBS at <https://fortress.wa.gov/ga/webs/>
1. In order to report payment detail, the Contractor must create an account with the DES Diversity Compliance program (B2Gnow) or verify if an account has already been created on behalf of the Contractor: <https://des.diversitycompliance.com>. B2Gnow is designed to streamline and automate compliance reporting requirements, empowering vendors to maintain accurate contact information and submit contract payment details online.
 2. For account login or account creation details, please refer to the Quick Reference Guides located on pages 4 - 6 or go to B2Gnow home page by clicking on the URL listed above and clicking on the "Help/First Time Users" link.
 3. Every month for the duration of your contract, and while your contract is active in the B2Gnow system, submit and accurately maintain the following payment information through B2Gnow:
 - a. Payments received by the prime contractor from the Agency
 - b. Payments paid to each first tier subcontractor
 - c. Payments paid to each first tier supplier
- You must also ensure the following information is reported in the B2Gnow system by your first tier subcontractors and suppliers for the duration of your contract:
- a. Confirmation of payments from the prime contractor to the subcontractor
 - b. Payment reporting to each supplier
- E. In accordance with RCW [39.04.320](#) the state of Washington requires 15% **Apprenticeship Participation** for all projects estimated to cost one million dollars or more. On applicable projects, the bid advertisement and Bid Form shall establish a minimum required percentage of apprentice labor hours compared to the total labor hours. Bidders may contact the Department of Labor and Industries, Specialty Compliance Services Division, Apprenticeship Section, P.O. Box 44530, Olympia, WA 98504-4530, by phone (360) 902-5320, and e-mail at Apprentice@lni.wa.gov, to obtain information on available apprenticeship programs.

0.01 PREPARATION OF BIDS – CONSTRUCTION

- A. Bids must be: (1) submitted on the Bid Form, or copies of forms, furnished by the Owner or the Owner's agent, and (2) signed in ink. The person signing a bid must initial each change appearing on any Bid Form. If the bid is made by a corporation, it shall be signed by the corporation's authorized designee. The address of the Bidder shall be typed or printed on the Bid Form in the space provided.
- B. The Bid Form may require Bidders to submit bid prices for one or more items on various bases, including: (1) lump sum base bid; (2) lump sum bid alternate prices; (3) unit prices; or (4) any combination of items 1 through 3 above.
- C. If the solicitation includes alternate bid items, failure to bid on the alternates may disqualify the bid. If bidding on all items is not required, Bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.
- D. Substitute bid forms will not be considered unless this solicitation authorizes their submission.

0.02 BID GUARANTEE

- A. When the sum of the base bid plus all additive bid alternates is \$35,000.00 or less, bid security is not required.

When the sum of the base bid plus all additive alternates is greater than \$35,000.00, a bid guarantee in the amount of 5% of the base bid amount is required. Failure of the Bidder to provide bid guarantee when required shall render the bid non-responsive.

- B. Acceptable forms of bid guarantee are: A bid bond or postal money order, or certified check or cashier's check made payable to the Washington State Treasurer.

The Owner will return bid guarantees (other than bid bond) to unsuccessful Bidders as soon as practicable, but not sooner than the execution of a contract with the successful Bidder. The successful Bidder's bid guarantee will be returned to the successful Bidder with its official notice to proceed with the work of the contract.

- C. The Bidder will allow 60 days from bid opening date for acceptance of its bid by the Owner.

The Bidder will return to the Owner a signed contract, insurance certificate and bond or bond waiver within 15 days after receipt of the contract. If the apparent successful Bidder fails to sign all contractual documents or provide the bond and insurance as required or return the documents within 15 days after receipt of the contract, the Owner may terminate the award of the contract.

- D. In the event a Bidder discovers an error in its bid following the bid opening, the Bidder may request to withdraw its bid under the following conditions:

1. Written notification is received by the Owner within 24 hours following bid opening.
2. The Bidder provides written documentation of the claimed error to the satisfaction of the Owner within 72 hours following the bid opening.

The Owner will approve or disapprove the request for withdrawal of the bid in writing. If the Bidder's request for withdrawal of its bid is approved, the Bidder will be released from further obligation to the Owner without penalty. If it is disapproved, the Owner may retain the Bidder's bid guarantee.

0.03 ADDITIVE OR DEDUCTIVE BID ITEMS

The low Bidder, for purposes of award, shall be the responsive Bidder offering the low aggregate amount for the base bid item, plus additive or deductive bid alternates selected by the Owner, and within funds available for the project.

The Bidder agrees to hold all bid alternate prices for sixty (60) days from date of bid opening.

0.04 ACKNOWLEDGEMENT OF ADDENDA

Bidders shall acknowledge receipt of all addenda to this solicitation by identifying the addenda numbers in the space provided for this purpose on the Bid Form. Failure to do so may result in the bid being declared non-responsive.

0.05 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK

The Bidder acknowledges that it has taken steps necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to; (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, electric power, and road; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during the work. The Bidder also acknowledges that it has satisfied itself as to character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including exploratory work done by the Owner, as well as from the drawings and specifications made a part of this contract. Any failure of the Bidder to take the actions described and acknowledged in this paragraph will not relieve the Bidder from responsibility for estimating properly the difficulty and cost of successfully performing the work.

0.06 BID AMOUNTS

- A. The bid prices shown for each item on the Bid Form shall include all labor, material, equipment, overhead and compensation to complete all of the work for that item.
- B. The actual cost of building permit (only) and the public utility hookup fees will be a direct reimbursement to the Contractor or paid directly to the permitting agency by the Owner. Fees for these permits should not be included by the Bidder in the bid amount.
- C. The Bidder agrees to hold the base bid prices for sixty (60) days from date of bid opening.

0.07 TAXES

The bid amounts shall not include Washington State Sales Tax (WSST). All other taxes imposed by law shall be included in the bid amount. The Owner will include WSST in progress payments. The Contractor shall pay the WSST to the Department of Revenue and shall furnish proof of payment to the Owner if requested.

[NOTE: Contractor must bond for contract amount plus the WSST.]

0.08 SUBMISSION OF BIDS

- A. Bids must be submitted on or before the time specified in the Advertisement for Bids.
- B. Subcontractor Listing: If the base bid and the sum of the additive alternates is one million dollars or more, the Bid Form shall comply with the following requirements:
 - 1. Pursuant to RCW [39.30.060](#), if the base bid and the sum of the additive alternates is one million dollars or more, the Bidder shall provide names of the Subcontractors with whom the Bidder will subcontract for performance of heating, ventilation and air conditioning (HVAC), plumbing, and electrical.
 - 2. The Bidder can name itself for the performance of the work.
 - 3. The Bidder shall not list more than one Subcontractor for each category of work identified UNLESS Subcontractors vary with bid alternates, in which case the Bidder must indicate which Subcontractor will be used for which alternate.

4. Failure of the Bidder to submit as part of the bid the NAMES of such Subcontractors or to name itself to perform such work shall render the Bidder's bid nonresponsive and, therefore, void.
- C. The Bid Form shall be submitted in a sealed envelope addressed to the office specified in the Advertisement for Bids. The envelope shall have printed on the outside:
1. The project number and description.
 2. The name and address of the Bidder.
 3. Identification as Bid Form.
- D. Prior to the bid opening, the Owner's representative will designate the official bid clock. Any part of the Bid Form, or in the rare situation of a bid modification, not received prior to the times specified, per the designated bid clock, will not be considered and the bid will be returned to the Bidder unopened.
- E. A bid may be withdrawn in person by a Bidder's authorized representative before the opening of the bids. Bidder(s) representative will be required to show ID and sign on bid summary sheet before it will be released.
- F. People with disabilities who wish to request special accommodation, (e.g., sign language interpreters, braille, etc.) need to contact the Owner ten (10) working days prior to the scheduled bid opening.

0.09 BID RESULTS

After the Bid Opening, Bidders may obtain bid results from the office of E&AS by calling (360) 902-7272 or by logging on to E&AS' web site: <https://fortress.wa.gov/ga/apps/EASbids/BidResult.aspx>. Bid results may also be obtained from the A/E.

0.10 LOW RESPONSIBLE BIDDER

- A. **Mandatory Responsibility Criteria:** Before award of a public works contract, a Bidder must meet the following mandatory responsibility criteria under RCW [39.04.350 \(1\) & \(2\)](#) to be considered a responsible Bidder and qualified to be awarded a public works project. The Bidder must:
1. At the time of bid submittal, have a certificate of registration in compliance with RCW [18.27](#);
 2. Have a current state unified business identifier number;
 3. If applicable, have industrial insurance coverage for the Bidder's employees working in Washington as required in RCW [51](#); an employment security department number as required in RCW [50](#); and a state excise tax registration number as required in RCW [82](#);
 4. Not be disqualified from bidding on any public works contract under RCW [39.06.010](#) or [39.12.065\(3\)](#);
 5. If bidding on a public works project subject to the apprenticeship utilization requirements in RCW [39.04.320](#), not have been found out of compliance by the Washington State Apprenticeship and Training Council for working apprentices out of ratio, without appropriate supervision, or outside their approved work processes as outlined in their standards of apprenticeship under RCW [49.04](#) for the one-year period immediately preceding the date of the bid solicitation;

6. **Public Works and Prevailing Wage Training/Exemption.** Bidders shall have received training on the requirements related to public works and prevailing wage under this chapter and chapter [39.12](#) RCW. The bidder must designate a person or persons to be trained on these requirements. The training must be provided by the department of labor and industries or by a training provider whose curriculum is approved by the department. The department, in consultation with the prevailing wage advisory committee, must determine the length of the training. Bidders that have completed three or more public works projects and have had a valid business license in Washington for three or more years are exempt from this subsection. The department of labor and industries must keep records of entities that have satisfied the training requirement or are exempt and make the records available on its website. Responsible parties may rely on the records made available by the department regarding satisfaction of the training requirement or exemption. <http://lni.wa.gov/TradesLicensing/PrevWage/Contractors/Training.asp>
 7. Within the three year period immediately preceding the date of the bid solicitation, not have been determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgement entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW [49.48.082](#), any provision of RCW [49.46](#), [49.48](#), or [49.52](#). A bidder shall submit a signed Contractor Certification form **with the bid or within two (2) business days of request by Owner** regarding this wage theft prevention responsible bidder criteria.
- B. Supplemental Responsibility Criteria:** In addition to the mandatory Bidder responsibility, the Owner may adopt relevant supplemental criteria for determining Bidder responsibility applicable to a particular project which the Bidder must meet (RCW [39.04.350](#) (3)).
1. If applicable, the Owner shall consider an overall accounting of the attached supplemental criteria for determining Bidder responsibility "DIVISION 00 SUPPLEMENTAL RESPONSIBILITY CRITERIA".
 2. At least seven (7) days prior to the bid submittal deadline, a potential Bidder may request that the Owner modify the supplemental responsibility criteria. The Owner will evaluate the information submitted by the potential Bidder and respond before the bid submittal deadline. If the evaluation results in a change of the criteria, the Owner will issue an addendum to the bidding documents identifying the new criteria.
 3. Upon Owner's request, the apparent low Bidder must supply the requested responsibility information within two (2) business days of request by Owner. Withholding information or failure to submit all the information requested within the time provided may render the bid non-responsive
 4. If the Owner determines that the apparent low Bidder is not responsible, the Owner will notify the Bidder of its preliminary determination in writing.
 5. Within three (3) days after receipt of the preliminary determination, the Bidder may withdraw its bid or request a hearing where the Bidder may appeal the preliminary determination and present additional information to the Owner.
 6. The Owner will schedule a hearing within three (3) working days of receipt of the Bidder's request. The hearing members will include a Client Agency Representative, EAS Assistant Director or designee, Deputy Assistant Director or designee, and Project Manager.
 7. The Owner will issue a Final Determination after reviewing information presented at the hearing.

8. If the Owner determines a Bidder to be not responsible, the Owner will provide, in writing, the reasons for the determination. If the final determination affirms that the Bidder is not responsible, the Owner will not execute a contract with any other Bidder until two (2) business days after the Bidder determined to be not responsible has received the final determination.
9. The Owner's Final Determination is specific to this project, and will have no effect on other or future projects.

0.11 CONTRACT AWARD

- A. The Owner will evaluate bids responsiveness and responsibility.
 1. A bid will be considered responsive if it meets the following requirements:
 - a. It is received at the proper time and place.
 - b. It meets the stated requirements of the Bid Form.
 - c. It is submitted by a licensed/registered contractor within the state of Washington at the time of bid opening and is not banned from bidding by the Department of Labor and Industries.
 - d. It is accompanied by a bid guarantee, if required.
 2. A bid will be considered responsible if it meets the following requirements:
 - a. It meets the mandatory responsibility criteria established in RCW [39.04.350](#) and an overall accounting of the supplemental responsibility criteria established for the project.
 - b. The bidder completes, signs, and submits the "Contractor Certification Wage Theft Prevention – Responsible Bidder Criteria" form **with their bid or within two (2) business days of request by the Owner.**
- B. The Owner reserves the right to accept or reject any or all bids and to waive informalities.
- C. The Owner may negotiate bid price adjustments with the low responsive Bidder, including changes in the contract documents, to bring the bid within the available funding per RCW [39.04.015](#).
- D. The apparent low Bidder, for purpose of award, shall be the responsive and responsible Bidder offering the low aggregate amount for the base bid plus selected additive or deductive bid alternates and meeting all other bid submittal requirements.
- E. **Reciprocal Preference for Resident Contractors.** For a public works bid received from a nonresident contractor from a state that provides an in-state percentage bidding preference, a Comparable Percentage Disadvantage (CPD) will be applied to the bid of that nonresident contractor. The CPD is the in-state contractor percent advantage provided by the contractor's home state.

For the purpose of determining the successful Bidder, multiply the Nonresident Contractor bid amount by the CPD. The "bid amount" shall be the total of the base bid and all accepted alternate bid items. The CPD shall be added to the Nonresident Contractor bid amount which equates to the Nonresident Disadvantage Total. The Nonresident Disadvantage Total shall be compared to the Washington contractor bid amounts. The Bidder with the lowest total shall be the successful Bidder. See example below:

EXAMPLE:

Alaska Nonresident Contractor Bid Amount	\$100,000
Multiplied by the Alaska CPD	x 0.05
Alaska CPD Total	\$ 5,000

Alaska Nonresident Contractor Bid Amount	\$100,000
Alaska CPD Total	\$ 5,000
Nonresident Disadvantage Total	\$105,000*

* Note – If the Nonresident Disadvantage Total is lower than all other Washington contractor bid amounts, the Alaska Nonresident Contractor is the successful Bidder and will be awarded a contract for the bid amount of \$100,000.

If the Nonresident Disadvantage Total is higher than a Washington contractor bid amount, the successful Washington Bidder will be awarded a contract for the bid amount.

F. The Contract will only become effective when signed by the Owner. Prior to the Owner's signature, any and all costs incurred shall be the sole responsibility of the Bidder.

0.12 DOCUMENTS (ATTACHED)

- A. Advertisement for Bids
- B. Bid Form
- C. Supplemental Bidder Responsibility Criteria (if applicable)
- D. Certificate of Insurance form
- E. Special Conditions (if applicable)

Note: AIA Payment Bond and Performance Bond current forms (A312) are required, when applicable. These forms will not be provided by the Owner.

Project Name: SCC Lair Remodel, 2019 Contract No.: 2019-167 G (2-1)

Contractor Name: _____

**STATE OF WASHINGTON
DEPARTMENT OF ENTERPRISE SERVICES
FACILITIES DIVISION, ENGINEERING & ARCHITECTURAL SERVICES
HAND DELIVER TO: COMMUNITY COLLEGES OF SPOKANE,
ESMERALDA CENTER – DISTRICT FACILITIES OFFICES,
3939 N. FREYA, MS 1035
SPOKANE, WASHINGTON 99217
(This is a new location for District Facilities Offices.)**

B I D F O R M

In compliance with the contract documents, the following bid form is submitted:

1) BASE BID (*Including Trench Excavation Safety Provisions*)

_____ \$ _____
(Please print dollar amount in space above) (do not include Washington State Sales Tax)

TRENCH EXCAVATION SAFETY PROVISIONS \$ _____
(Included also in Base Bid)

If the bid amount contains any work which requires trenching exceeding a depth of four feet, all costs for trench safety shall be included in the Base Bid **and indicated above** for adequate trench safety systems in compliance with Chapter 39.04 RCW. 49.17 RCW and WAC 296-155-650. Bidder must include a lump sum dollar amount in blank above (even if the value is \$0.00) to be responsive.

2) BID ALTERNATES (*Specify whether additive or deductive*)

- (1) Private Offices in Leadership Space \$ _____
- (2) Wood Ceiling \$ _____
- (3) Roller Shades \$ _____
- (4) New Rooftop Unit – MZU-5 \$ _____
- (5) _____ \$ _____
- (6) _____ \$ _____

Do not include Washington State Sales Tax in alternate amounts.

The Owner reserves the right to accept or reject any or all bid prices within sixty (60) days of the bid date.

TIME FOR COMPLETION:

Contract Time - The undersigned hereby agrees to Substantially Complete all the work under the Base Bid (and Alternates No. 1, 2 & 3 if accepted) within 112 calendar days after the date of Notice to Proceed. If Alternate No. 4, New Rooftop Unit - MZU-5 is accepted Substantial Completion shall be within 147

Project Name: SCC Lair Remodel, 2019 Contract No.: 2019-167 G (2-1)

Contractor Name: _____

calendar days after the date of Notice to Proceed. Alternate No. 4 work shall not proceed until Base Bid (and Alternates No. 1, 2, & 3 if accepted) work is Substantially Complete and occupied by Owner. For definition of Contractor normal work hours, see Section 01 11 00 – Summary of Work, Paragraph 1.07 – Working Hours.

Final Completion – All the Work shall be fully and finally completed in accordance with the contract documents within 30 calendar days after the date of Substantial Completion.

FEDERAL AND STATE REQUIREMENTS

The undersigned agrees to perform the requirements set out and incorporated by reference in attached "DIVISION 00 SPECIAL CONDITIONS" section in the specifications, if applicable.

LIQUIDATED DAMAGES

The undersigned agrees to pay the Owner as liquidated damages the sum of \$250.00 for each consecutive calendar day that is in default after the Contract Time. Liquidated damages shall be deducted from the contract invoice after taxes and retainage.

RECEIPT OF ADDENDA

Receipt of the following addenda is acknowledged:

Addendum No. _____
Addendum No. _____
Addendum No. _____

Addendum No. _____
Addendum No. _____
Addendum No. _____

Name of Firm _____		
NOTE: <i>If Bidder is a corporation, write State of Incorporation; if a partnership, give full names and addresses of all parties below.</i>		
Signed by _____	Official Capacity _____	
Print Name _____		
Address _____		
City _____	State _____	Zip Code _____
Date _____	Telephone _____	FAX _____
State of Washington Contractor's License No. _____		
Federal Tax ID # _____	E-mail address: _____	
Employment Security Department No. _____		

**CONTRACTOR CERTIFICATION
WAGE THEFT PREVENTION – RESPONSIBLE BIDDER CRITERIA
WASHINGTON STATE PUBLIC WORKS CONTRACTS**

Prior to awarding a public works contract, the Washington State Department of Enterprise Services is required to determine that a bidder meets the responsibility criteria to be considered a ‘responsible bidder’ and is qualified to be awarded a public works project. See [RCW 39.04.350\(1\)\(g\) & \(2\)](#). Pursuant to legislative enactment in 2017, the responsibility criteria include a contractor certification that the contractor has not willfully violated Washington’s wage laws. See Chap. 258, 2017 Laws (enacting SSB 5301).

Contract No.: 2019-167 G (2-1)

Project Name: SCC Lair Remodel, 2019

Procurement Solicitation Date: 12/23/19

I hereby certify, on behalf of the firm identified below, as follows (check one):

NO WAGE VIOLATIONS. This firm has NOT been determined by a final and binding citation and notice of assessment issued by the Washington Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in [RCW 49.48.082](#), any provision of RCW chapters [49.46](#), [49.48](#), or [49.52](#) within three (3) years prior to the date of the above-referenced procurement solicitation date.

OR

VIOLATIONS OF WAGE LAWS. This firm has been determined by a final and binding citation and notice of assessment issued by the Washington Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in [RCW 49.48.082](#), a provision of RCW chapters [49.46](#), [49.48](#), or [49.52](#) within three (3) years prior to the date of the above-referenced procurement solicitation date.

I hereby certify, under penalty of perjury under the laws of the State of Washington, that the certifications herein are true and correct and that I am authorized to make these certifications on behalf of the firm listed herein.

FIRM NAME: _____
Name of Contractor/Bidder – Print full legal entity name of firm

By: _____
Signature of authorized person Print Name of person making certifications for firm

Title: _____ Place: _____
Title of person signing certificate

Date: _____
Print city and state where signed

Return this signed ‘‘Contractor Certification’’ with your signed Bid Form.

Division 00
Supplemental Bidder
Responsibility Criteria
(Without Inclusion Plan and Apprenticeship Requirements)

Low Responsible Bidder

It is the intent of the Owner to award a contract to the lowest responsive and responsible Bidder. In determining the Bidder's responsibility, the Owner shall consider an overall accounting of the items listed below. Potential Bidders may request the Owner modify the Bidder responsibility criteria. The request must be in writing and submitted at least 7 days prior to the bid opening.

The apparent low bidder shall submit the required information within **two (2)** business days of receiving request from Owner. This request may be made in the form of a telephone call or email message. The required information shall be provided on the referenced forms bound herein. Electronic copies may be made available upon request. Failure to submit such information to the satisfaction of the Owner within the time provided may render the Bidder as not responsible.

Required Information/Criteria

For the purposes of the Supplemental Bidder Responsibility evaluation process, the scope of this project generally involves a fast-paced and phased interior remodeling of existing rooms to create new offices and student lounge area suites. HVAC and electrical systems shall be reconfigured to serve the plan changes. The project is located on an active community college campus. Adjacent occupied spaces need to remain in operation.

1. Experience of Contractor on Projects of Similar Size and Complexity

Contractor is required to have successfully completed projects of similar type, size and complexity.

List of Completed Projects (Use Form 1, Contractor Experience Detail)

Submit 5 projects of similar type, size and complexity to this project, each with a contract amount of at least \$500,000 that your firm has successfully completed within the past 5 years. Provide all information requested on Form 1. This information will be used for reference reviews.

2. Experience of Key Personnel

Experience of Project Manager (Use Form 2, Résumé of Key Personnel for Proposed Contract)

Submit resume and references for the proposed Project Manager. This person shall have managed, as lead project manager, a minimum of 3 projects of similar type, size and complexity to this project, and successfully completed those projects within the last 5 years.

Experience of Superintendent (Use Form 2, Résumé of Key Personnel for Proposed Contract)

Submit resume and references for the proposed project Superintendent. This person shall have performed as the lead Superintendent for a minimum of 3 projects of similar type, size and complexity to this project, and successfully completed those projects within the last 5 years.

3. Diverse Business Inclusion Plan (Not Required)

4. Apprenticeship (Not Required)

5. References from Owners and Architects for Previous Projects (Provided for Contractor Reference - Owner uses Form 5, Reference Evaluation Questionnaire)

The Owner may check references by contacting owners and architects of the bidder's previous projects regarding the bidder's performance and that of key staff. A reference score sheet will be utilized and the rating shall be satisfactory or better on a five-category scale with "satisfactory" at mid-scale.

6. Overall Scoring (Not Required – Provided for Contractor Reference – Owner uses Form 6, Responsibility Criteria Evaluation Score Sheet)

The Owner will use this form to complete and document the overall evaluation process.

Supplemental Bidder Responsibility Form 1 - Contractor Experience Detail Project 2019-167 G (2-1), SCC Lair Remodel, 2019

Business Contact Information

Contractor Name:	Total years in Business:
Mailing Address:	
Business Phone:	Former business name(s) & Dates:
Contact Name and Title:	
Contact Phone:	Contact Email:
	Reason for name change(s):

*List Projects Completed Within The Time Specified By Division 00, or Are In Progress					
* Project Name & Location:	Description Of Project:	Owner:	Architect:	Project Manager Name:	Original Contract Amount: Final Contract Amount: Original Contract Days Time Extensions Granted Days Completion Date:
	As Prime <input type="checkbox"/> Or Sub: <input type="checkbox"/>	Address:	Address:	Superintendent Name:	Is this project relevant to proposed project? Yes <input type="checkbox"/> No <input type="checkbox"/>
		Phone:	Phone:		
		Email:	Email:		
<p>1. Did this project require Apprenticeship Participation? Yes <input type="checkbox"/> No <input type="checkbox"/> (If NO, stop here).</p> <p>2. If yes, what was the Apprenticeship %? <input type="text"/> %</p> <p>3. What was the actual % achieved? <input type="text"/> %</p> <p>4. Was the apprenticeship requirement met? Yes <input type="checkbox"/> No <input type="checkbox"/></p> <p>If NO to question 4 attach separate sheet to explain Why.</p>					

**Supplemental Bidder Responsibility
Form 2 - Resume of Key Personnel for Proposed Contract
Project 2019-167 G (2-1), SCC Lair Remodel, 2019**

Name:	Role in this Contract:	Years Experience	
		Total	With Current Firm
Firm Name and Location (City and State):			
Training/Education/Specialization:			
Years of Experience in the Proposed Role:			

RELEVANT PROJECTS	
Project Title:	Year Completed
Project Owner:	
Brief Description (Brief scope, size, cost, etc.) and specific role:	Check if project performed with current firm. <input type="checkbox"/> If performed with different firm list the firm name
Reference Name & Contact Information:	
Project Owner:	Project Architect:
Name:	Name:
Phone:	Phone:
E-mail	E-mail:

RELEVANT PROJECTS	
Project Title:	Year Completed
Project Owner:	
Brief Description (Brief scope, size, cost, etc.) and specific role:	Check if project performed with current firm. <input type="checkbox"/> If performed with different firm list the firm name
Reference Name & Contact Information:	
Project Owner:	Project Architect:
Name:	Name:
Phone:	Phone:
E-mail	E-mail:

RELEVANT PROJECTS

Project Title:		Year Completed
Project Owner:		
Brief Description (Brief scope, size, cost, etc.) and specific role:		Check if project performed with current firm. <input type="checkbox"/> If performed with different firm list the firm Name
Reference Name & Contact Information:		
Project Owner:	Project Architect:	
Name:	Name:	
Phone:	Phone:	
E-mail	E-mail:	

RELEVANT PROJECTS

Project Title:		Year Completed
Project Owner:		
Brief Description (Brief scope, size, cost, etc.) and specific role:		Check if project performed with current firm. <input type="checkbox"/> If performed with different firm list the firm Name
Reference Name & Contact Information:		
Project Owner:	Project Architect:	
Name:	Name:	
Phone:	Phone:	
E-mail	E-mail:	

RELEVANT PROJECTS

Project Title:		Year Completed
Project Owner:		
Brief Description (Brief scope, size, cost, etc.) and specific role:		Check if project performed with current firm. <input type="checkbox"/> If performed with different firm list the firm Name
Reference Name & Contact Information:		
Project Owner:	Project Architect:	
Name:	Name:	
Phone:	Phone:	
E-mail	E-mail:	

**Supplemental Bidder Responsibility
Form 5 - Reference Evaluation Questionnaire
Project 2019-167 G (2-1), SCC Lair Remodel, 2019**

Evaluated Firm :
Project Manager:
Superintendent:
Evaluated Project Name:

- Prime
 Subcontractor

Approx. Start Date	Approx. End Date	Approx. Final Project Cost

PERFORMANCE EVALUATION

Rating Criteria - Rate on a scale of 1 to 5

- **5 = Superior** based on performance (would hire this firm/individual again)
- **4 = More than Satisfactory**
- **3 = Satisfactory** based on performance (would hire this firm/individual again)
- **2 = Less than Satisfactory**
- **1= Totally Unsatisfactory** based on performance (would never hire the firm/individual again)

	Criteria	Rating		
		Company	PM	Super
1	Ability to meet client's expectations			
2	Quality of workmanship			
3	Ability to manage project costs and minimize change orders			
4	Ability to maintain project schedule			
5	Ability to manage subcontractors			
6	Professionalism, leadership and communication in issues management (RFI, shop drawing submittal, timely resolution of issues/questions)			
7	Ability to follow the owner's rules, regulations, and requirements (housekeeping, safety, etc.)			
8	Ability to manage closeout process (Prompt submittal of punch list, warranty, as-builts, operation manuals, tax clearances, etc.)			
9	Comfort level in hiring firm or individual again based on performance			
	Total Score			
	Average Score			

Evaluator Information	
Name of Evaluator:	Title:
Firm/Company Name:	
Firm Address:	
Phone:	Email:

Form 6 – Supplemental Responsibility Criteria Evaluation Score Sheet

Project Title SCC Lair Remodel, 2019
 Project Number 2019-167 G (2-1)
 Project Manager _____
 Project Location _____
 Project Owner _____

1. Experience of Contractor - On projects of similar size & complexity (Form 1)	Pass or Fail
--	--------------

2. Experience of Key Personnel (Form 2)	
Superintendent	Pass or Fail
Project Manager	Pass or Fail
Other(s) if specified in Division 00	Pass or Fail

3. Diverse Business Inclusion Plan (Form 3) <i>(Applies only to projects with Diverse Business Plan Inclusion requirements; i.e. MACC over \$1M)</i>	Pass, Fail, or N/A
---	--------------------

4. Contractor Compliance with Apprenticeship Requirements - Requirements were met or if not, a good faith effort was demonstrated (Forms 1 & 4) <i>Applies only to projects with apprenticeship participation requirements; i.e. MACC over \$1M</i>	Not Scored
--	------------

5. References from Previous Projects (Form 5) Evaluate contractor's references information and using the rating numbers: 1 = NOT Satisfactory (requires a written comment below) 2 = Less THAN Satisfactory 3 = Satisfactory 4 = More THAN Satisfactory 5 = Superior	Rating Score 1-5 (3 is Satisfactory)
Company	
Project Manager	
Superintendent	
Total Score:	
Average score (divide total score by number of ratings)	

In determining the bidder responsibility, an overall accounting of the ratings shall be made. A score of "Pass" is required for categories 1 - 4 and an average score of 3.0 or higher is required to meet the minimum Supplemental Bidder Responsibility requirements.

Comments _____

Determination Responsible
 Not Responsible (Preliminary Determination)

Evaluated by E&AS PM (Typed or Printed Name) Date _____

Signature _____

Instructions to Bidders – July 1, 2019

General Conditions – July 2010

Annotated

Supplemental Conditions – June 1, 2018


For Washington State Facility Construction

Effective: July 1, 2019

Approved by:



William J. Frare, Assistant Director
Facilities Professional Services



Dawn Cortez, Assistant Attorney General
Washington State Office of the Attorney General



Facility Professional Services, Engineering & Architectural Services
PO Box 41476
Olympia, Washington 98504-1476
(360) 902-7272

**INSTRUCTIONS TO BIDDERS
FOR WASHINGTON STATE FACILITIES CONSTRUCTION
July 1, 2019**

PART 0 – GENERAL CONDITIONS

0.00 EXPLANATION TO PROSPECTIVE BIDDERS

- A. In accordance with RCW [39.04.380](#) effective *March 30, 2012*, the State of Washington is enforcing a **Reciprocal Preference for Resident Contractors**. Any public works bid received from a nonresident contractor from a state that provides an in-state percentage bidding preference, a comparable percentage disadvantage must be applied to the bid of that nonresident contractor.

A nonresident contractor from a state that provides a percentage bid preference means a contractor that:

1. Is from a state that provides a percentage bid preference to its resident contractors bidding on public works contracts.
2. At the time of bidding on a public works project, does not have a physical office located in Washington.

The state of residence for a nonresident contractor is the state in which the contractor was incorporated or, if not a corporation, the state where the contractor's business entity was formed.

All nonresident contractors will be evaluated for out-of-state Bidder preference. If the state of the nonresident contractor provides an in-state contractor preference, a comparable percentage disadvantage will be applied to their bid prior to contract award.

This section does not apply to public works procured pursuant to RCW [39.04.155](#), [39.04.280](#), or any other procurement exempt from competitive bidding.

- B. Any prospective Bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must submit a request in writing to the Architect/Engineer (A/E) seven (7) calendar days before the bid due date. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective Bidder concerning a solicitation will be furnished promptly to all other prospective Bidders by addendum to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective Bidders.
- C. In accordance with the legislative findings and policies set forth in RCW [39.19](#) the State of Washington encourages participation in all of its contracts by MWBE firms certified by the Office of Minority and Women's Business Enterprises (OMWBE). Participation may be either on a direct basis in response to this invitation or as a subcontractor to a Bidder. However, unless required by federal statutes, regulations, grants, or contract terms referenced in the contract documents, no preference will be included in the evaluation of bids, no minimum level of MWBE participation shall be required as a condition for receiving an award, and bids will not be rejected or considered non-responsive on that basis. Any affirmative action requirements set forth in federal regulations or statutes included or referenced in the contract documents will apply.

- D. The State of Washington encourages participation in all of its contracts by Veteran-owned businesses (defined in RCW [43.60.010](#)) and located at <http://www.dva.wa.gov/program/certified-veteran-and-servicemember-owned-businesses> and Small, Mini and Micro businesses (defined in RCW [39.26.010](#)) which have registered in WEBS at <https://fortress.wa.gov/ga/webs/>
1. In order to report payment detail, the Contractor must create an account with the DES Diversity Compliance program (B2Gnow) or verify if an account has already been created on behalf of the Contractor: <https://des.diversitycompliance.com>. B2Gnow is designed to streamline and automate compliance reporting requirements, empowering vendors to maintain accurate contact information and submit contract payment details online.
 2. For account login or account creation details, please refer to the Quick Reference Guides located on pages 4 - 6 or go to B2Gnow home page by clicking on the URL listed above and clicking on the "Help/First Time Users" link.
 3. Every month for the duration of your contract, and while your contract is active in the B2Gnow system, submit and accurately maintain the following payment information through B2Gnow:
 - a. Payments received by the prime contractor from the Agency
 - b. Payments paid to each first tier subcontractor
 - c. Payments paid to each first tier supplier
- You must also ensure the following information is reported in the B2Gnow system by your first tier subcontractors and suppliers for the duration of your contract:
- a. Confirmation of payments from the prime contractor to the subcontractor
 - b. Payment reporting to each supplier
- E. In accordance with RCW [39.04.320](#) the state of Washington requires 15% **Apprenticeship Participation** for all projects estimated to cost one million dollars or more. On applicable projects, the bid advertisement and Bid Form shall establish a minimum required percentage of apprentice labor hours compared to the total labor hours. Bidders may contact the Department of Labor and Industries, Specialty Compliance Services Division, Apprenticeship Section, P.O. Box 44530, Olympia, WA 98504-4530, by phone (360) 902-5320, and e-mail at Apprentice@lni.wa.gov, to obtain information on available apprenticeship programs.

0.01 PREPARATION OF BIDS – CONSTRUCTION

- A. Bids must be: (1) submitted on the Bid Form, or copies of forms, furnished by the Owner or the Owner's agent, and (2) signed in ink. The person signing a bid must initial each change appearing on any Bid Form. If the bid is made by a corporation, it shall be signed by the corporation's authorized designee. The address of the Bidder shall be typed or printed on the Bid Form in the space provided.
- B. The Bid Form may require Bidders to submit bid prices for one or more items on various bases, including: (1) lump sum base bid; (2) lump sum bid alternate prices; (3) unit prices; or (4) any combination of items 1 through 3 above.
- C. If the solicitation includes alternate bid items, failure to bid on the alternates may disqualify the bid. If bidding on all items is not required, Bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.
- D. Substitute bid forms will not be considered unless this solicitation authorizes their submission.

0.02 BID GUARANTEE

- A. When the sum of the base bid plus all additive bid alternates is \$35,000.00 or less, bid security is not required.

When the sum of the base bid plus all additive alternates is greater than \$35,000.00, a bid guarantee in the amount of 5% of the base bid amount is required. Failure of the Bidder to provide bid guarantee when required shall render the bid non-responsive.

- B. Acceptable forms of bid guarantee are: A bid bond or postal money order, or certified check or cashier's check made payable to the Washington State Treasurer.

The Owner will return bid guarantees (other than bid bond) to unsuccessful Bidders as soon as practicable, but not sooner than the execution of a contract with the successful Bidder. The successful Bidder's bid guarantee will be returned to the successful Bidder with its official notice to proceed with the work of the contract.

- C. The Bidder will allow 60 days from bid opening date for acceptance of its bid by the Owner.

The Bidder will return to the Owner a signed contract, insurance certificate and bond or bond waiver within 15 days after receipt of the contract. If the apparent successful Bidder fails to sign all contractual documents or provide the bond and insurance as required or return the documents within 15 days after receipt of the contract, the Owner may terminate the award of the contract.

- D. In the event a Bidder discovers an error in its bid following the bid opening, the Bidder may request to withdraw its bid under the following conditions:

1. Written notification is received by the Owner within 24 hours following bid opening.
2. The Bidder provides written documentation of the claimed error to the satisfaction of the Owner within 72 hours following the bid opening.

The Owner will approve or disapprove the request for withdrawal of the bid in writing. If the Bidder's request for withdrawal of its bid is approved, the Bidder will be released from further obligation to the Owner without penalty. If it is disapproved, the Owner may retain the Bidder's bid guarantee.

0.03 ADDITIVE OR DEDUCTIVE BID ITEMS

The low Bidder, for purposes of award, shall be the responsive Bidder offering the low aggregate amount for the base bid item, plus additive or deductive bid alternates selected by the Owner, and within funds available for the project.

The Bidder agrees to hold all bid alternate prices for sixty (60) days from date of bid opening.

0.04 ACKNOWLEDGEMENT OF ADDENDA

Bidders shall acknowledge receipt of all addenda to this solicitation by identifying the addenda numbers in the space provided for this purpose on the Bid Form. Failure to do so may result in the bid being declared non-responsive.

0.05 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK

The Bidder acknowledges that it has taken steps necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to; (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, electric power, and road; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during the work. The Bidder also acknowledges that it has satisfied itself as to character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including exploratory work done by the Owner, as well as from the drawings and specifications made a part of this contract. Any failure of the Bidder to take the actions described and acknowledged in this paragraph will not relieve the Bidder from responsibility for estimating properly the difficulty and cost of successfully performing the work.

0.06 BID AMOUNTS

- A. The bid prices shown for each item on the Bid Form shall include all labor, material, equipment, overhead and compensation to complete all of the work for that item.
- B. The actual cost of building permit (only) and the public utility hookup fees will be a direct reimbursement to the Contractor or paid directly to the permitting agency by the Owner. Fees for these permits should not be included by the Bidder in the bid amount.
- C. The Bidder agrees to hold the base bid prices for sixty (60) days from date of bid opening.

0.07 TAXES

The bid amounts shall not include Washington State Sales Tax (WSST). All other taxes imposed by law shall be included in the bid amount. The Owner will include WSST in progress payments. The Contractor shall pay the WSST to the Department of Revenue and shall furnish proof of payment to the Owner if requested.

[NOTE: Contractor must bond for contract amount plus the WSST.]

0.08 SUBMISSION OF BIDS

- A. Bids must be submitted on or before the time specified in the Advertisement for Bids.
- B. Subcontractor Listing: If the base bid and the sum of the additive alternates is one million dollars or more, the Bid Form shall comply with the following requirements:
 - 1. Pursuant to RCW [39.30.060](#), if the base bid and the sum of the additive alternates is one million dollars or more, the Bidder shall provide names of the Subcontractors with whom the Bidder will subcontract for performance of heating, ventilation and air conditioning (HVAC), plumbing, and electrical.
 - 2. The Bidder can name itself for the performance of the work.
 - 3. The Bidder shall not list more than one Subcontractor for each category of work identified UNLESS Subcontractors vary with bid alternates, in which case the Bidder must indicate which Subcontractor will be used for which alternate.

4. Failure of the Bidder to submit as part of the bid the NAMES of such Subcontractors or to name itself to perform such work shall render the Bidder's bid nonresponsive and, therefore, void.
- C. The Bid Form shall be submitted in a sealed envelope addressed to the office specified in the Advertisement for Bids. The envelope shall have printed on the outside:
1. The project number and description.
 2. The name and address of the Bidder.
 3. Identification as Bid Form.
- D. Prior to the bid opening, the Owner's representative will designate the official bid clock. Any part of the Bid Form, or in the rare situation of a bid modification, not received prior to the times specified, per the designated bid clock, will not be considered and the bid will be returned to the Bidder unopened.
- E. A bid may be withdrawn in person by a Bidder's authorized representative before the opening of the bids. Bidder(s) representative will be required to show ID and sign on bid summary sheet before it will be released.
- F. People with disabilities who wish to request special accommodation, (e.g., sign language interpreters, braille, etc.) need to contact the Owner ten (10) working days prior to the scheduled bid opening.

0.09 BID RESULTS

After the Bid Opening, Bidders may obtain bid results from the office of E&AS by calling (360) 902-7272 or by logging on to E&AS' web site: <https://fortress.wa.gov/ga/apps/EASbids/BidResult.aspx>. Bid results may also be obtained from the A/E.

0.10 LOW RESPONSIBLE BIDDER

- A. **Mandatory Responsibility Criteria:** Before award of a public works contract, a Bidder must meet the following mandatory responsibility criteria under RCW [39.04.350 \(1\) & \(2\)](#) to be considered a responsible Bidder and qualified to be awarded a public works project. The Bidder must:
1. At the time of bid submittal, have a certificate of registration in compliance with RCW [18.27](#);
 2. Have a current state unified business identifier number;
 3. If applicable, have industrial insurance coverage for the Bidder's employees working in Washington as required in RCW [51](#); an employment security department number as required in RCW [50](#); and a state excise tax registration number as required in RCW [82](#);
 4. Not be disqualified from bidding on any public works contract under RCW [39.06.010](#) or [39.12.065\(3\)](#);
 5. If bidding on a public works project subject to the apprenticeship utilization requirements in RCW [39.04.320](#), not have been found out of compliance by the Washington State Apprenticeship and Training Council for working apprentices out of ratio, without appropriate supervision, or outside their approved work processes as outlined in their standards of apprenticeship under RCW [49.04](#) for the one-year period immediately preceding the date of the bid solicitation;

6. **Public Works and Prevailing Wage Training/Exemption.** Bidders shall have received training on the requirements related to public works and prevailing wage under this chapter and chapter [39.12](#) RCW. The bidder must designate a person or persons to be trained on these requirements. The training must be provided by the department of labor and industries or by a training provider whose curriculum is approved by the department. The department, in consultation with the prevailing wage advisory committee, must determine the length of the training. Bidders that have completed three or more public works projects and have had a valid business license in Washington for three or more years are exempt from this subsection. The department of labor and industries must keep records of entities that have satisfied the training requirement or are exempt and make the records available on its website. Responsible parties may rely on the records made available by the department regarding satisfaction of the training requirement or exemption. <http://lni.wa.gov/TradesLicensing/PrevWage/Contractors/Training.asp>
 7. Within the three year period immediately preceding the date of the bid solicitation, not have been determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgement entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW [49.48.082](#), any provision of RCW [49.46](#), [49.48](#), or [49.52](#). A bidder shall submit a signed Contractor Certification form **with the bid or within two (2) business days of request by Owner** regarding this wage theft prevention responsible bidder criteria.
- B. Supplemental Responsibility Criteria:** In addition to the mandatory Bidder responsibility, the Owner may adopt relevant supplemental criteria for determining Bidder responsibility applicable to a particular project which the Bidder must meet (RCW [39.04.350](#) (3)).
1. If applicable, the Owner shall consider an overall accounting of the attached supplemental criteria for determining Bidder responsibility "DIVISION 00 SUPPLEMENTAL RESPONSIBILITY CRITERIA".
 2. At least seven (7) days prior to the bid submittal deadline, a potential Bidder may request that the Owner modify the supplemental responsibility criteria. The Owner will evaluate the information submitted by the potential Bidder and respond before the bid submittal deadline. If the evaluation results in a change of the criteria, the Owner will issue an addendum to the bidding documents identifying the new criteria.
 3. Upon Owner's request, the apparent low Bidder must supply the requested responsibility information within two (2) business days of request by Owner. Withholding information or failure to submit all the information requested within the time provided may render the bid non-responsive
 4. If the Owner determines that the apparent low Bidder is not responsible, the Owner will notify the Bidder of its preliminary determination in writing.
 5. Within three (3) days after receipt of the preliminary determination, the Bidder may withdraw its bid or request a hearing where the Bidder may appeal the preliminary determination and present additional information to the Owner.
 6. The Owner will schedule a hearing within three (3) working days of receipt of the Bidder's request. The hearing members will include a Client Agency Representative, EAS Assistant Director or designee, Deputy Assistant Director or designee, and Project Manager.
 7. The Owner will issue a Final Determination after reviewing information presented at the hearing.

8. If the Owner determines a Bidder to be not responsible, the Owner will provide, in writing, the reasons for the determination. If the final determination affirms that the Bidder is not responsible, the Owner will not execute a contract with any other Bidder until two (2) business days after the Bidder determined to be not responsible has received the final determination.
9. The Owner's Final Determination is specific to this project, and will have no effect on other or future projects.

0.11 CONTRACT AWARD

- A. The Owner will evaluate bids responsiveness and responsibility.
 1. A bid will be considered responsive if it meets the following requirements:
 - a. It is received at the proper time and place.
 - b. It meets the stated requirements of the Bid Form.
 - c. It is submitted by a licensed/registered contractor within the state of Washington at the time of bid opening and is not banned from bidding by the Department of Labor and Industries.
 - d. It is accompanied by a bid guarantee, if required.
 2. A bid will be considered responsible if it meets the following requirements:
 - a. It meets the mandatory responsibility criteria established in RCW [39.04.350](#) and an overall accounting of the supplemental responsibility criteria established for the project.
 - b. The bidder completes, signs, and submits the "Contractor Certification Wage Theft Prevention – Responsible Bidder Criteria" form **with their bid or within two (2) business days of request by the Owner.**
- B. The Owner reserves the right to accept or reject any or all bids and to waive informalities.
- C. The Owner may negotiate bid price adjustments with the low responsive Bidder, including changes in the contract documents, to bring the bid within the available funding per RCW [39.04.015](#).
- D. The apparent low Bidder, for purpose of award, shall be the responsive and responsible Bidder offering the low aggregate amount for the base bid plus selected additive or deductive bid alternates and meeting all other bid submittal requirements.
- E. **Reciprocal Preference for Resident Contractors.** For a public works bid received from a nonresident contractor from a state that provides an in-state percentage bidding preference, a Comparable Percentage Disadvantage (CPD) will be applied to the bid of that nonresident contractor. The CPD is the in-state contractor percent advantage provided by the contractor's home state.

For the purpose of determining the successful Bidder, multiply the Nonresident Contractor bid amount by the CPD. The "bid amount" shall be the total of the base bid and all accepted alternate bid items. The CPD shall be added to the Nonresident Contractor bid amount which equates to the Nonresident Disadvantage Total. The Nonresident Disadvantage Total shall be compared to the Washington contractor bid amounts. The Bidder with the lowest total shall be the successful Bidder. See example below:

EXAMPLE:

Alaska Nonresident Contractor Bid Amount	\$100,000
Multiplied by the Alaska CPD	x 0.05
Alaska CPD Total	\$ 5,000

Alaska Nonresident Contractor Bid Amount	\$100,000
Alaska CPD Total	\$ 5,000
Nonresident Disadvantage Total	\$105,000*

* Note – If the Nonresident Disadvantage Total is lower than all other Washington contractor bid amounts, the Alaska Nonresident Contractor is the successful Bidder and will be awarded a contract for the bid amount of \$100,000.

If the Nonresident Disadvantage Total is higher than a Washington contractor bid amount, the successful Washington Bidder will be awarded a contract for the bid amount.

F. The Contract will only become effective when signed by the Owner. Prior to the Owner's signature, any and all costs incurred shall be the sole responsibility of the Bidder.

0.12 DOCUMENTS (ATTACHED)

- A. Advertisement for Bids
- B. Bid Form
- C. Supplemental Bidder Responsibility Criteria (if applicable)
- D. Certificate of Insurance form
- E. Special Conditions (if applicable)

Note: AIA Payment Bond and Performance Bond current forms (A312) are required, when applicable. These forms will not be provided by the Owner.

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PART 1 – GENERAL PROVISIONS

1.01 DEFINITIONS

- A. “Application for Payment” means a written request submitted by Contractor to A/E for payment of Work completed in accordance with the Contract Documents and approved Schedule of Values, supported by such substantiating data as Owner or A/E may require.
- B. “Architect,” “Engineer,” or “A/E” means a person or entity lawfully entitled to practice architecture or engineering, representing Owner within the limits of its delegated authority.
- C. “Change Order” means a written instrument signed by Owner and Contractor stating their agreement upon all of the following: (1) a change in the Work; (2) the amount of the adjustment in the Contract Sum, if any, and (3) the extent of the adjustment in the Contract Time, if any.
- D. “Claim” means Contractor’s exclusive remedy for resolving disputes with Owner regarding the terms of a Change Order or a request for equitable adjustment, as more fully set forth in Part 8.
- E. “Contract Award Amount” is the sum of the Base Bid and any accepted Alternates.
- F. “Contract Documents” means the Advertisement for Bids, Instructions for Bidders, completed Bid Form, General Conditions, Modifications to the General Conditions, Supplemental Conditions, Public Works Contract, other Special Forms, Drawings and Specifications, and all addenda and modifications thereof.
- G. “Contract Sum” is the total amount payable by Owner to Contractor, for performance of the Work in accordance with the Contract Documents, including all taxes imposed by law and properly chargeable to the Work, except Washington State sales tax.
- H. “Contract Time” is the number of calendar days allotted in the Contract Documents for achieving Substantial Completion of the Work.
- I. “Contractor” means the person or entity who has agreed with Owner to perform the Work in accordance with the Contract Documents.
- J. “Day(s)”: Unless otherwise specified, day(s) shall mean calendar day(s).”
- K. “Drawings” are the graphic and pictorial portions of the Contract Documents showing the design, location, and dimensions of the Work, and may include plans, elevations, sections, details, schedules, and diagrams.
- L. “Final Acceptance” means the written acceptance issued to Contractor by Owner after Contractor has completed the requirements of the Contract Documents, as more fully set forth in Section 6.09 B.
- M. “Final Completion” means that the Work is fully and finally complete in accordance with the Contract Documents, as more fully set forth in Section 6.09 A.
- N. “Force Majeure” means those acts entitling Contractor to request an equitable adjustment in the Contract Time, as more fully set forth in paragraph 3.05A.
- O. “Notice” means a written notice which has been delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended or, if delivered or sent by registered or certified mail, to the last business address known to the party giving notice.

- P. "Notice to Proceed" means a notice from Owner to Contractor that defines the date on which the Contract Time begins to run.
- Q. "Owner" means the state agency, institution, or its authorized representative with the authority to enter into, administer, and/or terminate the Work in accordance with the Contract Documents and make related determinations and findings.
- R. "Person" means a corporation, partnership, business association of any kind, trust, company, or individual.
- S. "Prior Occupancy" means Owner's use of all or parts of the Project before Substantial Completion, as more fully set forth in Section 6.08 A.
- T. "Progress Schedule" means a schedule of the Work, in a form satisfactory to Owner, as further set forth in Section 3.02.
- U. "Project" means the total construction of which the Work performed in accordance with the Contract Documents may be the whole or a part and which may include construction by Owner or by separate contractors.
- V. "Project Record" means the separate set of Drawings and Specifications as further set forth in paragraph 4.02A.
- W. "Schedule of Values" means a written breakdown allocating the total Contract Sum to each principal category of Work, in such detail as requested by Owner.
- X. "Specifications" are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards and workmanship for the Work, and performance of related services.
- Y. "Subcontract" means a contract entered into by Subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind for or in connection with the Work.
- Z. "Subcontractor" means any person, other than Contractor, who agrees to furnish or furnishes any supplies, materials, equipment, or services of any kind in connection with the Work.
- AA. "Substantial Completion" means that stage in the progress of the Work when the construction is sufficiently complete, as more fully set forth in Section 6.07.
- AB. "Work" means the construction and services required by the Contract Documents, and includes, but is not limited to, labor, materials, supplies, equipment, services, permits, and the manufacture and fabrication of components, performed, furnished, or provided in accordance with the Contract Documents.

1.02 ORDER OF PRECEDENCE

Any conflict or inconsistency in the Contract Documents shall be resolved by giving the documents precedence in the following order:

1. Signed Public Works Contract, including any Change Orders.
2. Supplemental Conditions.
3. Modifications to the General Conditions.
4. General Conditions.

5. Specifications. Provisions in Division 1 shall take precedence over provisions of any other Division.
6. Drawings. In case of conflict within the Drawings, large scale drawings shall take precedence over small scale drawings.
7. Signed and Completed Bid Form.
8. Instructions to Bidders.
9. Advertisement for Bids.

1.03 EXECUTION AND INTENT

Contractor Representations: Contractor makes the following representations to Owner:

1. Contract Sum reasonable: The Contract Sum is reasonable compensation for the Work and the Contract Time is adequate for the performance of the Work, as represented by the Contract Documents;
2. Contractor familiar with project: Contractor has carefully reviewed the Contract Documents, visited and examined the Project site, become familiar with the local conditions in which the Work is to be performed, and satisfied itself as to the nature, location, character, quality and quantity of the Work, the labor, materials, equipment, goods, supplies, work, services and other items to be furnished and all other requirements of the Contract Documents, as well as the surface and subsurface conditions and other matters that may be encountered at the Project site or affect performance of the Work or the cost or difficulty thereof;
3. Contractor financially capable: Contractor is financially solvent, able to pay its debts as they mature, and possesses sufficient working capital to complete the Work and perform Contractor's obligations required by the Contract Documents; and
4. Contractor can complete Work: Contractor is able to furnish the plant, tools, materials, supplies, equipment and labor required to complete the Work and perform the obligations required by the Contract Documents and has sufficient experience and competence to do so.

PART 2 – INSURANCE AND BONDS

2.01 CONTRACTOR'S LIABILITY INSURANCE

General insurance requirements: Prior to commencement of the Work, Contractor shall obtain all the insurance required by the Contract Documents and provide evidence satisfactory to Owner that such insurance has been procured. Review of the Contractor's insurance by Owner shall not relieve or decrease the liability of Contractor. Companies writing the insurance to be obtained by this part shall be licensed to do business under Chapter 48 RCW or comply with the Surplus Lines Law of the State of Washington. Contractor shall include in its bid the cost of all insurance and bond costs required to complete the base bid work and accepted alternates. Insurance carriers providing insurance in accordance with the Contract Documents shall be acceptable to Owner, and its A.M. Best rating shall be indicated on the insurance certificates.

- A. Term of insurance coverage: Contractor shall maintain the following insurance coverage during the Work and for one year after Final Acceptance. Contractor shall also maintain the following insurance coverage during the performance of any corrective Work required by Section 5.16.

1. General Liability Insurance: Commercial General Liability (CGL) on an Occurrence Form. Coverage shall include, but not be limited to:
 - a. Completed operations/products liability;
 - b. Explosion, collapse, and underground; and
 - c. Employer's liability coverage.
 2. Automobile Liability Insurance: Automobile liability
- B. Industrial Insurance compliance: Contractor shall comply with the Washington State Industrial Insurance Act and, if applicable, the Federal Longshoremen's and Harbor Workers' Act and the Jones Act.
- C. Insurance to protect for the following: All insurance coverages shall protect against claims for damages for personal and bodily injury or death, as well as claims for property damage, which may arise from operations in connection with the Work whether such operations are by Contractor or any Subcontractor.
- D. Owner as Additional Insured: All insurance coverages shall be endorsed to include Owner as an additional named insured for Work performed in accordance with the Contract Documents, and all insurance certificates shall evidence the Owner as an additional insured.

2.02 COVERAGE LIMITS

Insurance amounts: The coverage

- A. Limits of Liability shall not be less than:
 - Property Damage (other than Automobile Liability)
 - Advertising Liability
 - Each Accident or Loss.
- B. \$2,000,000 Combined Single Limit
- C. \$2,000,000 Annual Aggregate Limit
- D. \$1,000,000 Combined Single Limit

See Supplemental Conditions 2.02 which replaces General Conditions Section 2.02.

mit for Bodily Injury and
e; Personal Injury and
ability.
roperty Damage Liability,

2.03 INSURANCE COVERAGE CERTIFICATES

- A. Certificate required: Prior to commencement of the Work, Contractor shall furnish to Owner a completed certificate of insurance coverage.
- B. List Project info: All insurance certificates shall name Owner's Project number and Project title.
- C. Cancellation provisions: All insurance certificates shall specifically require 45 Days prior notice to Owner of cancellation or any material change, except 30 Days for surplus line insurance.

2.04 PAYMENT AND PERFORMANCE BONDS

Conditions for bonds: Payment and performance bonds, including state sales tax, shall be furnished for the Work, using the form published by and available from the American Institute of Architects, Form of a Change Order that, cumulatively with previous bonds, shall not exceed an Amount by 15% or more, the Contractor shall provide either new payment and performance bonds for the

See Supplemental Conditions 2.04 which replaces General Conditions Section 2.04.

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revised Contract Sum, or riders to the existing payment and performance bonds increasing the amount of the bonds. The Contractor shall likewise provide additional bonds or riders when subsequent Change Orders increase the Contract Sum by 15% or more. No payment or performance bond is required if the Contract Sum is \$35,000 or less and Contractor agrees that Owner may, in lieu of the bond, retain 50% of the Contract Sum for the period allowed by RCW 39.08.010.

2.05 ALTERNATIVE SURETY

When alternative surety required: Contractor shall promptly furnish payment and performance bonds from an alternative surety as required to protect Owner and persons supplying labor or materials required by the Contract Documents if:

- A. Owner has a reasonable objection to the surety; or
- B. Any surety fails to furnish reports on its financial condition if required by Owner.

2.06 BUILDER'S RISK

- A. Contractor to buy Property Insurance: Contractor shall purchase and maintain property insurance in the amount of the Contract Sum including all Change Orders for the Work on a replacement cost basis until Substantial Completion. For projects not involving New Building Construction, "Installation Floater" is an acceptable substitute for the Builder's Risk Insurance. The insurance shall cover the interest of Owner, Contractor, and any Subcontractors, as their interests may appear.
- B. Losses covered: Contractor property insurance shall be placed on an "all risk" basis and insure against the perils of fire and extended coverage and physical loss or damage including theft, vandalism, malicious mischief, collapse, false work, temporary buildings, debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for A/E's services and expenses required as a result of an insured loss.
- C. Waiver of subrogation rights: Owner and Contractor waive all subrogation rights against each other, any Subcontractors, A/E, A/E's subconsultants, separate contractors described in Section 5.20, if any, and any of their subcontractors, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this section or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by Owner as fiduciary. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

PART 3 – TIME AND SCHEDULE

3.01 PROGRESS AND COMPLETION

Contractor to meet schedule: Contractor shall diligently prosecute the Work, with adequate forces, achieve Substantial Completion within the Contract Time, and achieve Final Completion within a reasonable period thereafter.

3.02 CONSTRUCTION SCHEDULE

- A. Preliminary Progress Schedule: Unless otherwise provided in Division 1, Contractor shall, within 14 Days after issuance of the Notice to Proceed, submit a preliminary Progress Schedule. The Progress Schedule shall show the sequence in which Contractor proposes to perform the Work,

and the dates on which Contractor plans to start and finish major portions of the Work, including dates for shop drawings and other submittals, and for acquiring materials and equipment.

- B. Form of Progress Schedule: See Supplemental Conditions 3.02 which replaces General Conditions Section 3.02 B. Progress Schedule shall be in the form of a bar chart prepared by Owner. The preliminary Progress Schedule shall be used for the Work, with a more detailed Progress Schedule to be submitted by Contractor.
- C. Owner comments on Progress Schedule: Owner shall return comments on the preliminary Progress Schedule to Contractor within 14 Days of receipt. Review by Owner of Contractor's schedule does not constitute an approval or acceptance of Contractor's construction means, methods, or sequencing, or its ability to complete the Work within the Contract Time. Contractor shall revise and resubmit its schedule, as necessary. Owner may withhold a portion of progress payments until a Progress Schedule has been submitted which meets the requirements of this section.
- D. Monthly updates and compliance with Progress Schedule: Contractor shall utilize and comply with the Progress Schedule. On a monthly basis, or as otherwise directed by Owner, Contractor shall submit an updated Progress Schedule at its own expense to Owner indicating actual progress. If, in the opinion of Owner, Contractor is not in conformance with the Progress Schedule for reasons other than acts of Force Majeure as identified in Section 3.05, Contractor shall take such steps as are necessary to bring the actual completion dates of its work activities into conformance with the Progress Schedule, and if directed by Owner, Contractor shall submit a corrective action plan or revise the Progress Schedule to reconcile with the actual progress of the Work.
- E. Contractor to notify Owner of delays: Contractor shall promptly notify Owner in writing of any actual or anticipated event which is delaying or could delay achievement of any milestone or performance of any critical path activity of the Work. Contractor shall indicate the expected duration of the delay, the anticipated effect of the delay on the Progress Schedule, and the action being or to be taken to correct the problem. Provision of such notice does not relieve Contractor of its obligation to complete the Work within the Contract Time.

3.03 OWNER'S RIGHT TO SUSPEND THE WORK FOR CONVENIENCE

- A. Owner may suspend Work: Owner may, at its sole discretion, order Contractor, in writing, to suspend all or any part of the Work for up to 90 Days, or for such longer period as mutually agreed.
- B. Compliance with suspension; Owner's options: Upon receipt of a written notice suspending the Work, Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of cost of performance directly attributable to such suspension. Within a period up to 90 Days after the notice is delivered to Contractor, or within any extension of that period to which the parties shall have agreed, Owner shall either:
1. Cancel the written notice suspending the Work; or
 2. Terminate the Work covered by the notice as provided in the termination provisions of Part 9.
- C. Resumption of Work: If a written notice suspending the Work is cancelled or the period of the notice or any extension thereof expires, Contractor shall resume Work.
- D. Equitable Adjustment for suspensions: Contractor shall be entitled to an equitable adjustment in the Contract Time, or Contract Sum, or both, for increases in the time or cost of performance

directly attributable to such suspension, provided Contractor complies with all requirements set forth in Part 7.

3.04 OWNER'S RIGHT TO STOP THE WORK FOR CAUSE

- A. Owner may stop Work for Contractor's failure to perform: If Contractor fails or refuses to perform its obligations in accordance with the Contract Documents, Owner may order Contractor, in writing, to stop the Work, or any portion thereof, until satisfactory corrective action has been taken.
- B. No Equitable Adjustment for Contractor's failure to perform: Contractor shall not be entitled to an equitable adjustment in the Contract Time or Contract Sum for any increased cost or time of performance attributable to Contractor's failure or refusal to perform or from any reasonable remedial action taken by Owner based upon such failure.

3.05 DELAY

- A. Force Majeure actions not a default; Force Majeure defined: Any delay in or failure of performance by Owner or Contractor, other than the payment of money, shall not constitute a default hereunder if and to the extent the cause for such delay or failure of performance was unforeseeable and beyond the control of the party ("Force Majeure"). Acts of Force Majeure include, but are not limited to:
1. Acts of God or the public enemy;
 2. Acts or omissions of any government entity;
 3. Fire or other casualty for which Contractor is not responsible;
 4. Quarantine or epidemic;
 5. Strike or defensive lockout;
 6. Unusually severe weather conditions which could not have been reasonably anticipated; and
 7. Unusual delay in receipt of supplies or products which were ordered and expedited and for which no substitute reasonably acceptable to Owner was available.
- B. Contract Time adjustment for Force Majeure: Contractor shall be entitled to an equitable adjustment in the Contract Time for changes in the time of performance directly attributable to an act of Force Majeure, provided it makes a request for equitable adjustment according to Section 7.03. Contractor shall not be entitled to an adjustment in the Contract Sum resulting from an act of Force Majeure.
- C. Contract Time or Contract Sum adjustment if Owner at fault: Contractor shall be entitled to an equitable adjustment in Contract Time, and may be entitled to an equitable adjustment in Contract Sum, if the cost or time of Contractor's performance is changed due to the fault or negligence of Owner, provided the Contractor makes a request according to Sections 7.02 and 7.03.
- D. No Contract Time or Contract Sum adjustment if Contractor at fault: Contractor shall not be entitled to an adjustment in Contract Time or in the Contract Sum for any delay or failure of performance to the extent such delay or failure was caused by Contractor or anyone for whose acts Contractor is responsible.

- E. Contract Time adjustment only for concurrent fault: To the extent any delay or failure of performance was concurrently caused by the Owner and Contractor, Contractor shall be entitled to an adjustment in the Contract Time for that portion of the delay or failure of performance that was concurrently caused, provided it makes a request for equitable adjustment according to Section 7.03, but shall not be entitled to an adjustment in Contract Sum.
- F. Contractor to mitigate delay impacts: Contractor shall make all reasonable efforts to prevent and mitigate the effects of any delay, whether occasioned by an act of Force Majeure or otherwise.

3.06 NOTICE TO OWNER OF LABOR DISPUTES

- A. Contractor to notify Owner of labor disputes: If Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay timely performance in accordance with the Contract Documents, Contractor shall immediately give notice, including all relevant information, to Owner.
- B. Pass through notification provisions to Subcontractors: Contractor agrees to insert a provision in its Subcontracts and to require insertion in all sub-subcontracts, that in the event timely performance of any such contract is delayed or threatened by delay by any actual or potential labor dispute, the Subcontractor or Sub-subcontractor shall immediately notify the next higher tier Subcontractor or Contractor, as the case may be, of all relevant information concerning the dispute.

3.07 DAMAGES FOR FAILURE TO ACHIEVE TIMELY COMPLETION

A. Liquidated Damages

1. Reason for Liquidated Damages: Timely performance and completion of the Work is essential to Owner and time limits stated in the Contract Documents are of the essence. Owner will incur serious and substantial damages if Substantial Completion of the Work does not occur within the Contract Time. However, it would be difficult if not impossible to determine the exact amount of such damages. Consequently, provisions for liquidated damages are included in the Contract Documents.
2. Calculation of Liquidated Damages amount: The liquidated damage amounts set forth in the Contract Documents will be assessed not as a penalty, but as liquidated damages for breach of the Contract Documents. This amount is fixed and agreed upon by and between the Contractor and Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain. This amount shall be construed as the actual amount of damages sustained by the Owner, and may be retained by the Owner and deducted from periodic payments to the Contractor.
3. Contractor responsible even if Liquidated Damages assessed: Assessment of liquidated damages shall not release Contractor from any further obligations or liabilities pursuant to the Contract Documents.

B. Actual Damages

Calculation of Actual Damages: Actual damages will be assessed for failure to achieve Final Completion within the time provided. Actual damages will be calculated on the basis of direct architectural, administrative, and other related costs attributable to the Project from the date when Final Completion should have been achieved, based on the date Substantial Completion is actually achieved, to the date Final Completion is actually achieved. Owner may offset these costs against any payment due Contractor.

PART 4 – SPECIFICATIONS, DRAWINGS, AND OTHER DOCUMENTS

4.01 DISCREPANCIES AND CONTRACT DOCUMENT REVIEW

- A. Specifications and Drawings are basis of the Work: The intent of the Specifications and Drawings is to describe a complete Project to be constructed in accordance with the Contract Documents. Contractor shall furnish all labor, materials, equipment, tools, transportation, permits, and supplies, and perform the Work required in accordance with the Drawings, Specifications, and other provisions of the Contract Documents.
- B. Parts of the Contract Documents are complementary: The Contract Documents are complementary. What is required by one part of the Contract Documents shall be binding as if required by all. Anything mentioned in the Specifications and not shown on the Drawings, or shown on the Drawings and not mentioned in the Specifications, shall be of like effect as if shown or mentioned in both.
- C. Contractor to report discrepancies in Contract Documents: Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by Owner. If, during the performance of the Work, Contractor finds a conflict, error, inconsistency, or omission in the Contract Documents, it shall promptly and before proceeding with the Work affected thereby, report such conflict, error, inconsistency, or omission to A/E in writing.
- D. Contractor knowledge of discrepancy in documents – responsibility: Contractor shall do no Work without applicable Drawings, Specifications, or written modifications, or Shop Drawings where required, unless instructed to do so in writing by Owner. If Contractor performs any construction activity, and it knows or reasonably should have known that any of the Contract Documents contain a conflict, error, inconsistency, or omission, Contractor shall be responsible for the performance and shall bear the cost for its correction.
- E. Contractor to perform Work implied by Contract Documents: Contractor shall provide any work or materials the provision of which is clearly implied and is within the scope of the Contract Documents even if the Contract Documents do not mention them specifically.
- F. Interpretation questions referred to A/E: Questions regarding interpretation of the requirements of the Contract Documents shall be referred to the A/E.

4.02 PROJECT RECORD

- A. Contractor to maintain Project Record Drawings and Specifications: Contractor shall legibly mark in ink on a separate set of the Drawings and Specifications all actual construction, including depths of foundations, horizontal and vertical locations of internal and underground utilities and appurtenances referenced to permanent visible and accessible surface improvements, field changes of dimensions and details, actual suppliers, manufacturers and trade names, models of installed equipment, and Change Order Proposals (COP). This separate set of Drawings and Specifications shall be the "Project Record."
- B. Update Project Record weekly and keep on site: The Project Record shall be maintained on the project site throughout the construction and shall be clearly labeled "PROJECT RECORD." The Project Record shall be updated at least weekly noting all changes and shall be available to Owner at all times.
- C. Final Project Record to A/E before Final Acceptance: Contractor shall submit the completed and finalized Project Record to A/E prior to Final Acceptance.

4.03 SHOP DRAWINGS

- A. Definition of Shop Drawings: "Shop Drawings" means documents and other information required to be submitted to A/E by Contractor pursuant to the Contract Documents, showing in detail: the proposed fabrication and assembly of structural elements; and the installation (i.e. form, fit, and attachment details) of materials and equipment. Shop Drawings include, but are not limited to, drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, samples, and similar materials furnished by Contractor to explain in detail specific portions of the Work required by the Contract Documents. For materials and equipment to be incorporated into the Work, Contractor submittal shall include the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the item. When directed, Contractor shall submit all samples at its own expense. Owner may duplicate, use, and disclose Shop Drawings provided in accordance with the Contract Documents.
- B. Approval of Shop Drawings by Contractor and A/E: Contractor shall coordinate all Shop Drawings, and review them for accuracy, completeness, and compliance with the Contract Documents and shall indicate its approval thereon as evidence of such coordination and review. Where required by law, Shop Drawings shall be stamped by an appropriate professional licensed by the state of Washington. Shop Drawings submitted to A/E without evidence of Contractor's approval shall be returned for resubmission. Contractor shall review, approve, and submit Shop Drawings with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of Owner or separate contractors. Contractor's submittal schedule shall allow a reasonable time for A/E review. A/E will review, approve, or take other appropriate action on the Shop Drawings. Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings until the respective submittal has been reviewed and the A/E has approved or taken other appropriate action. Owner and A/E shall respond to Shop Drawing submittals with reasonable promptness. Any Work by Contractor shall be in accordance with reviewed Shop Drawings. Submittals made by Contractor which are not required by the Contract Documents may be returned without action.
- C. Contractor not relieved of responsibility when Shop Drawings approved: Approval, or other appropriate action with regard to Shop Drawings, by Owner or A/E shall not relieve Contractor of responsibility for any errors or omissions in such Shop Drawings, nor from responsibility for compliance with the requirements of the Contract Documents. Unless specified in the Contract Documents, review by Owner or A/E shall not constitute an approval of the safety precautions employed by Contractor during construction, or constitute an approval of Contractor's means or methods of construction. If Contractor fails to obtain approval before installation and the item or work is subsequently rejected, Contractor shall be responsible for all costs of correction.
- D. Variations between Shop Drawings and Contract Documents: If Shop Drawings show variations from the requirements of the Contract Documents, Contractor shall describe such variations in writing, separate from the Shop Drawings, at the time it submits the Shop Drawings containing such variations. If A/E approves any such variation, an appropriate Change Order will be issued. If the variation is minor and does not involve an adjustment in the Contract Sum or Contract Time, a Change Order need not be issued; however, the modification shall be recorded upon the Project Record.
- E. Contractor to submit 5 copies of Shop Drawings: Unless otherwise provided in Division 1, Contractor shall submit to A/E for approval 5 copies of all Shop Drawings. Unless otherwise indicated, 3 sets of all Shop Drawings shall be retained by A/E and 2 sets shall be returned to Contractor.

4.04 ORGANIZATION OF SPECIFICATIONS

Specification organization by trade: Specifications are prepared in sections which conform generally with trade practices. These sections are for Owner and Contractor convenience and shall not control Contractor in dividing the Work among the Subcontractors or in establishing the extent of the Work to be performed by any trade.

4.05 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS, AND OTHER DOCUMENTS

- A. A/E, not Contractor, owns Copyright of Drawings and Specifications: The Drawings, Specifications, and other documents prepared by A/E are instruments of A/E's service through which the Work to be executed by Contractor is described. Neither Contractor nor any Subcontractor shall own or claim a copyright in the Drawings, Specifications, and other documents prepared by A/E, and A/E shall be deemed the author of them and will, along with any rights of Owner, retain all common law, statutory, and other reserved rights, in addition to the copyright. All copies of these documents, except Contractor's set, shall be returned or suitably accounted for to A/E, on request, upon completion of the Work.
- B. Drawings and Specifications to be used only for this Project: The Drawings, Specifications, and other documents prepared by the A/E, and copies thereof furnished to Contractor, are for use solely with respect to this Project. They are not to be used by Contractor or any Subcontractor on other projects or for additions to this Project outside the scope of the Work without the specific written consent of Owner and A/E. Contractor and Subcontractors are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications, and other documents prepared by A/E appropriate to and for use in the execution of their Work.
- C. Shop Drawing license granted to Owner: Contractor and all Subcontractors grant a non-exclusive license to Owner, without additional cost or royalty, to use for its own purposes (including reproduction) all Shop Drawings, together with the information and diagrams contained therein, prepared by Contractor or any Subcontractor. In providing Shop Drawings, Contractor and all Subcontractors warrant that they have authority to grant to Owner a license to use the Shop Drawings, and that such license is not in violation of any copyright or other intellectual property right. Contractor agrees to defend and indemnify Owner pursuant to the indemnity provisions in Section 5.03 and 5.22 from any violations of copyright or other intellectual property rights arising out of Owner's use of the Shop Drawings hereunder, or to secure for Owner, at Contractor's own cost, licenses in conformity with this section.
- D. Shop Drawings to be used only for this Project: The Shop Drawings and other submittals prepared by Contractor, Subcontractors of any tier, or its or their equipment or material suppliers, and copies thereof furnished to Contractor, are for use solely with respect to this Project. They are not to be used by Contractor or any Subcontractor of any tier, or material or equipment supplier, on other projects or for additions to this Project outside the scope of the Work without the specific written consent of Owner. The Contractor, Subcontractors of any tier, and material or equipment suppliers are granted a limited license to use and reproduce applicable portions of the Shop Drawings and other submittals appropriate to and for use in the execution of their Work under the Contract Documents.

PART 5 – PERFORMANCE

5.01 CONTRACTOR CONTROL AND SUPERVISION

- A. Contractor responsible for Means and Methods of construction: Contractor shall supervise and direct the Work, using its best skill and attention, and shall perform the Work in a skillful manner. Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work, unless the

Contract Documents give other specific instructions concerning these matters. Contractor shall disclose its means and methods of construction when requested by Owner.

- B. Competent Superintendent required: See Supplemental Conditions 5.01 which replaces General Conditions Sections 5.01 B & D. vised by a
t must be
of Owner.
ect site, if
ctionable,
period for
competent superintendent who has a satisfactory to the Owner and shall not be removed from the Work unless the Owner may require Contractor to remove the superintendent if the superintendent is not competent, provided Owner has first notified Contractor in writing of the deficiency and a reasonable period for transition.
- C. Contractor responsible for acts and omissions of self and agents: Contractor shall be responsible to Owner for acts and omissions of Contractor, Subcontractors, and their employees and agents.
- D. Contractor to employ competent and disciplined workforce: See Supplemental Conditions 5.01 which replaces General Conditions Sections 5.01 B & D. strict
performing
assigned to
sures fair,
e, request
ly deems
Contractor shall enforce strict discipline and good order among all of the Work. Contractor shall not permit anyone to be on the Work who is not competent, qualified, or properly trained. Contractor's employees shall adhere to the same standards of equal, and nondiscriminatory treatment. Contractor shall remove from the Work any employee who is incompetent, careless, or otherwise objectionable.
- E. Contractor to keep project documents on site: Contractor shall keep on the Project site a copy of the Drawings, Specifications, addenda, reviewed Shop Drawings, and permits and permit drawings.
- F. Contractor to comply with ethical standards: Contractor shall ensure that its owner(s) and employees, and those of its Subcontractors, comply with the Ethics in Public Service Act RCW 42.52, which, among other things, prohibits state employees from having an economic interest in any public works contract that was made by, or supervised by, that employee. Contractor shall remove, at its sole cost and expense, any of its, or its Subcontractors' employees, if they are in violation of this act.

5.02 PERMITS, FEES, AND NOTICES

- A. Contractor to obtain and pay for permits: Unless otherwise provided in the Contract Documents, Contractor shall pay for and obtain all permits, licenses, and inspections necessary for proper execution and completion of the Work. Prior to Final Acceptance, the approved, signed permits shall be delivered to Owner.
- B. Allowances for permit fees: See Supplemental Conditions 5.02 which replaces General Conditions Section 5.02 B & and adds a new Section 5.02 D. for in the Contract
permits or fees differ
justed by Change
If the allowances for permit fees in the Contract Documents and set forth in the Contract Order differ from the allowances in the Contract Order, the allowances in the Contract Order shall control.
- C. Contractor to comply with all applicable laws: Contractor shall comply with and give notices required by all federal, state, and local laws, ordinances, rules, regulations, and lawful orders of public authorities applicable to performance of the Work.

5.03 PATENTS AND ROYALTIES

Payment, indemnification, and notice: Contractor is responsible for, and shall pay, all royalties and license fees. Contractor shall defend, indemnify, and hold Owner harmless from any costs, expenses, and liabilities arising out of the infringement by Contractor of any patent, copyright, or other intellectual property right used in the Work; however, provided that Contractor gives prompt notice, Contractor shall not be responsible for such defense or indemnity when a particular design, process, or product of a

particular manufacturer or manufacturers is required by the Contract Documents. If Contractor has reason to believe that use of the required design, process, or product constitutes an infringement of a patent or copyright, it shall promptly notify Owner of such potential infringement.

5.04 PREVAILING WAGES

- A. Contractor to pay Prevailing Wages: workers, laborers, or mechanics employed in accordance with RCW 39.12 and the Industries. The schedule of prevailing wages is determined by the Industrial Statistician of the Department of Labor and Industries. Contractor's responsibility to verify the accuracy of the schedule of prevailing wages is to all Work in the project, including but not limited to labor and mechanics. Work, is the responsibility of the Contractor.

See Supplemental Conditions 5.04 which replaces General Conditions Sections 5.04 A & G.

- B. Statement of Intent to Pay Prevailing Wages: Before payment is made by the Owner to the Contractor for any work performed by the Contractor and subcontractors whose work is included in the application for payment, the Contractor shall submit, or shall have previously submitted to the Owner for the Project, a Statement of Intent to Pay Prevailing Wages, approved by the Department of Labor and Industries, certifying the rate of hourly wage paid and to be paid each classification of laborers, workers, or mechanics employed upon the Work by Contractor and Subcontractors. Such rates of hourly wage shall not be less than the prevailing wage rate.
- C. Affidavit of Wages Paid: Prior to release of retainage, the Contractor shall submit to the Owner an Affidavit of Wages Paid, approved by the Department of Labor and Industries, for the Contractor and every subcontractor, of any tier, that performed work on the Project.
- D. Disputes: Disputes regarding prevailing wage rates shall be referred for arbitration to the Director of the Department of Labor and Industries. The arbitration decision shall be final and conclusive and binding on all parties involved in the dispute as provided for by RCW 39.12.060.
- E. Statement with pay application; Post Statements of Intent at job site: Each Application for Payment submitted by Contractor shall state that prevailing wages have been paid in accordance with the prefiled statement(s) of intent, as approved. Copies of the approved intent statement(s) shall be posted on the job site with the address and telephone number of the Industrial Statistician of the Department of Labor and Industries where a complaint or inquiry concerning prevailing wages may be made.
- F. Contractor to pay for Statements of Intent and Affidavits: In compliance with chapter 296-127 WAC, Contractor shall pay to the Department of Labor and Industries the currently established fee(s) for each statement of intent and/or affidavit of wages paid submitted to the Department of Labor and Industries for certification.
- G. Certified Payrolls: Consistent with WAC 296-127-010, Contractor shall submit a certified copy of payroll records to the Department of Labor and Industries.

See Supplemental Conditions 5.04 which replaces General Conditions Sections 5.04 A & G.

5.05 HOURS OF LABOR

- A. Overtime: Contractor shall comply with all applicable provisions of RCW 49.28 and they are incorporated herein by reference. Pursuant to that statute, no laborer, worker, or mechanic employed by Contractor, any Subcontractor, or any other person performing or contracting to do the whole or any part of the Work, shall be permitted or required to work more than eight hours in any one calendar day, provided, that in cases of extraordinary emergency, such as danger to life or property, the hours of work may be extended, but in such cases the rate of pay for time employed in excess of eight hours of each calendar day shall be not less than one and one-half times the rate allowed for this same amount of time during eight hours of service.

- B. 4-10 Agreements: Notwithstanding the preceding paragraph, RCW 49.28 permits a contractor or subcontractor in any public works contract subject to those provisions, to enter into an agreement with its employees in which the employees work up to ten hours in a calendar day. No such agreement may provide that the employees work ten-hour days for more than four calendar days a week. Any such agreement is subject to approval by the employees. The overtime provisions of RCW 49.28 shall not apply to the hours, up to forty hours per week, worked pursuant to any such agreement.

5.06 NONDISCRIMINATION

- A. Discrimination prohibited: See Supplemental Conditions 5.06 which replaces General Conditions Section 5.06 A. es of employment is prohibited by, among other things Act of 1964, the Vietnam Era Veterans Re 04 of the Vocational Rehabilitation Act of 1973 Discrimination Act of 1967, the Americans with of 1991, Presidential Executive Order 11246, Executive Order 11575, the Washington State Law Against Discrimination, RCW 49.60, and Gubernatorial Executive Order 85-09. These laws and regulations establish minimum requirements for affirmative action and fair employment practices which Contractor must meet.

B. During performance of the Work:

1. Protected Classes: Contractor shall not discriminate against any employee or applicant for employment because of race, creed, color, national origin, sex, age, marital status, or the presence of any physical, sensory, or mental disability, Vietnam era veteran status, or disabled veteran status, nor commit any other unfair practices as defined in RCW 49.60.
2. Advertisements to state nondiscrimination: Contractor shall, in all solicitations or advertisements for employees placed by or for it, state that all qualified applicants will be considered for employment, without regard to race, creed, color, national origin, sex, age, marital status, or the presence of any physical, sensory, or mental disability.
3. Contractor to notify unions and others of nondiscrimination: Contractor shall send to each labor union, employment agency, or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice advising the labor union, employment agency, or workers' representative of Contractor's obligations according to the Contract Documents and RCW 49.60.
4. Owner and State access to Contractor records: Contractor shall permit access to its books, records, and accounts, and to its premises by Owner, and by the Washington State Human Rights Commission, for the purpose of investigation to ascertain compliance with this section of the Contract Documents.
5. Pass through provisions to Subcontractors: Contractor shall include the provisions of this section in every Subcontract.

5.07 SAFETY PRECAUTIONS

- A. Contractor responsible for safety: See Supplemental Conditions 5.07 which replaces General Conditions Section 5.07 A. maintaining, and supervising all safety precautions a of the Work.
- B. Contractor safety responsibilities: In carrying out its responsibilities according to the Contract Documents, Contractor shall protect the lives and health of employees performing the Work and other persons who may be affected by the Work; prevent damage to materials, supplies, and equipment whether on site or stored off-site; and prevent damage to other property at the site or adjacent thereto. Contractor shall comply with all applicable laws, ordinances, rules, regulations,

and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss; shall erect and maintain all necessary safeguards for such safety and protection; and shall notify owners of adjacent property and utilities when prosecution of the Work may affect them.

- C. Contractor to maintain safety records: Contractor shall maintain an accurate record of exposure data on all incidents relating to the Work resulting in death, traumatic injury, occupational disease, or damage to property, materials, supplies, or equipment. Contractor shall immediately report any such incident to Owner. Owner shall, at all times, have a right of access to all records of exposure.
- D. Contractor to provide HazMat training: Contractor shall provide all persons working on the Project site with information and training on hazardous chemicals in their work at the time of their initial assignment, and whenever a new hazard is introduced into their work area.
1. Information. At a minimum, Contractor shall inform persons working on the Project site of:
 - a. WAC: The requirements of chapter 296-62 WAC, General Occupational Health Standards;
 - b. Presence of hazardous chemicals: Any operations in their work area where hazardous chemicals are present; and
 - c. Hazard communications program: The location and availability of written hazard communication programs, including the required list(s) of hazardous chemicals and material safety data sheets required by chapter 296-62 WAC.
 2. Training. At a minimum, Contractor shall provide training for persons working on the Project site which includes:
 - a. Detecting hazardous chemicals: Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);
 - b. Hazards of chemicals: The physical and health hazards of the chemicals in the work area;
 - c. Protection from hazards: The measures such persons can take to protect themselves from these hazards, including specific procedures Contractor, or its Subcontractors, or others have implemented to protect those on the Project site from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and
 - d. Hazard communications program: The details of the hazard communications program developed by Contractor, or its Subcontractors, including an explanation of the labeling system and the material safety data sheet, and how employees can obtain and use the appropriate hazard information.
- E. Hazardous, toxic or harmful substances: Contractor's responsibility for hazardous, toxic, or harmful substances shall include the following duties:
1. Illegal use of dangerous substances: Contractor shall not keep, use, dispose, transport, generate, or sell on or about the Project site, any substances now or hereafter designated as, or which are subject to regulation as, hazardous, toxic, dangerous, or

harmful by any federal, state or local law, regulation, statute or ordinance (hereinafter collectively referred to as "hazardous substances"), in violation of any such law, regulation, statute, or ordinance, but in no case shall any such hazardous substance be stored more than 90 Days on the Project site.

2. Contractor notifications of spills, failures, inspections, and fines: Contractor shall promptly notify Owner of all spills or releases of any hazardous substances which are otherwise required to be reported to any regulatory agency and pay the cost of cleanup. Contractor shall promptly notify Owner of all failures to comply with any federal, state, or local law, regulation, or ordinance; all inspections of the Project site by any regulatory entity concerning the same; all regulatory orders or fines; and all responses or interim cleanup actions taken by or proposed to be taken by any government entity or private party on the Project site.
- F. Public safety and traffic: All Work shall be performed with due regard for the safety of the public. Contractor shall perform the Work so as to cause a minimum of interruption of vehicular traffic or inconvenience to pedestrians. All arrangements to care for such traffic shall be Contractor's responsibilities. All expenses involved in the maintenance of traffic by way of detours shall be borne by Contractor.
- G. Contractor to act in an emergency: In an emergency affecting the safety of life or the Work or of adjoining property, Contractor is permitted to act, at its discretion, to prevent such threatened loss or injury, and Contractor shall so act if so authorized or instructed.
- H. No duty of safety by Owner or A/E: Nothing provided in this section shall be construed as imposing any duty upon Owner or A/E with regard to, or as constituting any express or implied assumption of control or responsibility over, Project site safety, or over any other safety conditions relating to employees or agents of Contractor or any of its Subcontractors, or the public.

5.08 OPERATIONS, MATERIAL HANDLING, AND STORAGE AREAS

- A. Limited storage areas: Contractor shall confine all operations, including storage of materials, to Owner-approved areas.
- B. Temporary buildings and utilities at Contractor expense: Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be provided by Contractor only with the consent of Owner and without expense to Owner. The temporary buildings and utilities shall be removed by Contractor at its expense upon completion of the Work.
- C. Roads and vehicle loads: Contractor shall use only established roadways or temporary roadways authorized by Owner. When materials are transported in prosecuting the Work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by federal, state, or local law or regulation.
- D. Ownership and reporting by Contractor of demolished materials: Ownership and control of all materials or facility components to be demolished or removed from the Project site by Contractor shall immediately vest in Contractor upon severance of the component from the facility or severance of the material from the Project site. Contractor shall be responsible for compliance with all laws governing the storage and ultimate disposal. Contractor shall provide Owner with a copy of all manifests and receipts evidencing proper disposal when required by Owner or applicable law.
- E. Contractor responsible for care of materials and equipment on-site: Contractor shall be responsible for the proper care and protection of its materials and equipment delivered to the Project site. Materials and equipment may be stored on the premises subject to approval of

Owner. When Contractor uses any portion of the Project site as a shop, Contractor shall be responsible for any repairs, patching, or cleaning arising from such use.

- F. Contractor responsible for loss of materials and equipment: Contractor shall protect and be responsible for any damage or loss to the Work, or to the materials or equipment until the date of Substantial Completion, and shall repair or replace without cost to Owner any damage or loss that may occur, except damages or loss caused by the acts or omissions of Owner. Contractor shall also protect and be responsible for any damage or loss to the Work, or to the materials or equipment, after the date of Substantial Completion, and shall repair or replace without cost to Owner any such damage or loss that might occur, to the extent such damages or loss are caused by the acts or omissions of Contractor, or any Subcontractor.

5.09 PRIOR NOTICE OF EXCAVATION

- A. Excavation defined; Use of locator services: "Excavation" means an operation in which earth, rock, or other material on or below the ground is moved or otherwise displaced by any means, except the tilling of soil less than 12 inches in depth for agricultural purposes, or road ditch maintenance that does not change the original road grade or ditch flow line. Before commencing any excavation, Contractor shall provide notice of the scheduled commencement of excavation to all owners of underground facilities or utilities, through locator services.

5.10 UNFORESEEN PHYSICAL CONDITIONS

- A. Notice requirement for concealed or unknown conditions: If Contractor encounters conditions at the site which are subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or unknown physical conditions of an unusual nature which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then Contractor shall give written notice to Owner promptly and in no event later than 7 Days after the first observance of the conditions. Conditions shall not be disturbed prior to such notice.
- B. Adjustment in Contract Time and Contract Sum: If such conditions differ materially and cause a change in Contractor's cost of, or time required for, performance of any part of the Work, the Contractor may be entitled to an equitable adjustment in the Contract Time or Contract Sum, or both, provided it makes a request therefore as provided in Part 7.

5.11 PROTECTION OF EXISTING STRUCTURES, EQUIPMENT, VEGETATION, UTILITIES AND IMPROVEMENTS

- A. Contractor to protect and repair property: Contractor shall protect from damage all existing structures, equipment, improvements, utilities, and vegetation: at or near the Project site; and on adjacent property of a third party, the locations of which are made known to or should be known by Contractor. Contractor shall repair any damage, including that to the property of a third party, resulting from failure to comply with the requirements of the Contract Documents or failure to exercise reasonable care in performing the Work. If Contractor fails or refuses to repair the damage promptly, Owner may have the necessary work performed and charge the cost to Contractor.
- B. Tree and vegetation protection: Contractor shall only remove trees when specifically authorized to do so, and shall protect vegetation that will remain in place.

5.12 LAYOUT OF WORK

- A. Advanced planning of the Work: Contractor shall plan and lay out the Work in advance of operations so as to coordinate all work without delay or revision.

- B. Layout responsibilities: Contractor shall lay out the Work from Owner-established baselines and bench marks indicated on the Drawings, and shall be responsible for all field measurements in connection with the layout. Contractor shall furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the Work. Contractor shall be responsible for executing the Work to the lines and grades that may be established. Contractor shall be responsible for maintaining or restoring all stakes and other marks established.

5.13 MATERIAL AND EQUIPMENT

- A. Contractor to provide new and equivalent equipment and materials: All equipment, material, and articles incorporated into the Work shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in the Contract Documents. References in the Specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard quality and shall not be construed as limiting competition. Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of A/E, is equal to that named in the specifications, unless otherwise specifically provided in the Contract Documents.
- B. Contractor responsible for fitting parts together: Contractor shall do all cutting, fitting, or patching that may be required to make its several parts fit together properly, or receive or be received by work of others set forth in, or reasonably implied by, the Contract Documents. Contractor shall not endanger any work by cutting, excavating, or otherwise altering the Work and shall not cut or alter the work of any other contractor unless approved in advance by Owner.
- C. Owner may reject defective Work: Should any of the Work be found defective, or in any way not in accordance with the Contract Documents, this work, in whatever stage of completion, may be rejected by Owner.

5.14 AVAILABILITY AND USE OF UTILITY SERVICES

- A. Owner to provide and charge for utilities: Owner shall make all reasonable utilities available to Contractor from existing outlets and supplies, as specified in the Contract Documents. Unless otherwise provided in the Contract Documents, the utility service consumed shall be charged to or paid for by Contractor at prevailing rates charged to Owner or, where the utility is produced by Owner, at reasonable rates determined by Owner. Contractor will carefully conserve any utilities furnished.
- B. Contractor to install temporary connections and meters: Contractor shall, at its expense and in a skillful manner satisfactory to Owner, install and maintain all necessary temporary connections and distribution lines, together with appropriate protective devices, and all meters required to measure the amount of each utility used for the purpose of determining charges. Prior to the date of Final Acceptance, Contractor shall remove all temporary connections, distribution lines, meters, and associated equipment and materials.

5.15 TESTS AND INSPECTION

- A. Contractor to provide for all testing and inspection of Work: Contractor shall maintain an adequate testing and inspection program and perform such tests and inspections as are necessary or required to ensure that the Work conforms to the requirements of the Contract Documents. Contractor shall be responsible for inspection and quality surveillance of all its Work and all Work performed by any Subcontractor. Unless otherwise provided, Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. Contractor shall give Owner timely notice of when and

where tests and inspections are to be made. Contractor shall maintain complete inspection records and make them available to Owner.

- B. Owner may conduct tests and inspections: Owner may, at any reasonable time, conduct such inspections and tests as it deems necessary to ensure that the Work is in accordance with the Contract Documents. Owner shall promptly notify Contractor if an inspection or test reveals that the Work is not in accordance with the Contract Documents. Unless the subject items are expressly accepted by Owner, such Owner inspection and tests are for the sole benefit of Owner and do not:
1. Constitute or imply acceptance;
 2. Relieve Contractor of responsibility for providing adequate quality control measures;
 3. Relieve Contractor of responsibility for risk of loss or damage to the Work, materials, or equipment;
 4. Relieve Contractor of its responsibility to comply with the requirements of the Contract Documents; or
 5. Impair Owner's right to reject defective or nonconforming items, or to avail itself of any other remedy to which it may be entitled.
- C. Inspections or inspectors do not modify Contract Documents: Neither observations by an inspector retained by Owner, the presence or absence of such inspector on the site, nor inspections, tests, or approvals by others, shall relieve Contractor from any requirement of the Contract Documents, nor is any such inspector authorized to change any term or condition of the Contract Documents.
- D. Contractor responsibilities on inspections: Contractor shall promptly furnish, without additional charge, all facilities, labor, material and equipment reasonably needed for performing such safe and convenient inspections and tests as may be required by Owner. Owner may charge Contractor any additional cost of inspection or testing when Work is not ready at the time specified by Contractor for inspection or testing, or when prior rejection makes reinspection or retest necessary. Owner shall perform its inspections and tests in a manner that will cause no undue delay in the Work.

5.16 CORRECTION OF NONCONFORMING WORK

- A. Work covered by Contractor without inspection: If a portion of the Work is covered contrary to the requirements in the Contract Documents, it must, if required in writing by Owner, be uncovered for Owner's observation and be replaced at the Contractor's expense and without change in the Contract Time.
- B. Payment provisions for uncovering covered Work: If, at any time prior to Final Completion, Owner desires to examine the Work, or any portion of it, which has been covered, Owner may request to see such Work and it shall be uncovered by Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an adjustment in the Contract Sum for the costs of uncovering and replacement, and, if completion of the Work is thereby delayed, an adjustment in the Contract Time, provided it makes such a request as provided in Part 7. If such Work is not in accordance with the Contract Documents, the Contractor shall pay the costs of examination and reconstruction.
- C. Contractor to correct and pay for non-conforming Work: Contractor shall promptly correct Work found by Owner not to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed, or

completed. Contractor shall bear all costs of correcting such nonconforming Work, including additional testing and inspections.

- D. Contractor's compliance with warranty provisions: If, within one year after the date of Substantial Completion of the Work or designated portion thereof, or within one year after the date for commencement of any system warranties established under Section 6.08, or within the terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, Contractor shall correct it promptly after receipt of written notice from Owner to do so. Owner shall give such notice promptly after discovery of the condition. This period of one year shall be extended, with respect to portions of Work first performed after Substantial Completion, by the period of time between Substantial Completion and the actual performance of the Work. Contractor's duty to correct with respect to Work repaired or replaced shall run for one year from the date of repair or replacement. Obligations under this paragraph shall survive Final Acceptance.
- E. Contractor to remove non-conforming Work: Contractor shall remove from the Project site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by Contractor nor accepted by Owner.
- F. Owner may charge Contractor for non-conforming Work: If Contractor fails to correct nonconforming Work within a reasonable time after written notice to do so, Owner may replace, correct, or remove the nonconforming Work and charge the cost thereof to the Contractor.
- G. Contractor to pay for damaged Work during correction: Contractor shall bear the cost of correcting destroyed or damaged Work, whether completed or partially completed, caused by Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.
- H. No Period of limitation on other requirements: Nothing contained in this section shall be construed to establish a period of limitation with respect to other obligations which Contractor might have according to the Contract Documents. Establishment of the time period of one year as described in Section 5.16D relates only to the specific obligation of Contractor to correct the Work, and has no relationship to the time within which the Contractor's obligation to comply with the Contract Documents may be sought to be enforced, including the time within which such proceedings may be commenced.
- I. Owner may accept non-conforming Work and charge Contractor: If Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, Owner may do so instead of requiring its removal and correction, in which case the Contract Sum may be reduced as appropriate and equitable.

5.17 CLEAN UP

Contractor to keep site clean and leave it clean: Contractor shall at all times keep the Project site, including hauling routes, infrastructures, utilities, and storage areas, free from accumulations of waste materials. Before completing the Work, Contractor shall remove from the premises its rubbish, tools, scaffolding, equipment, and materials. Upon completing the Work, Contractor shall leave the Project site in a clean, neat, and orderly condition satisfactory to Owner. If Contractor fails to clean up as provided herein, and after reasonable notice from Owner, Owner may do so and the cost thereof shall be charged to Contractor.

5.18 ACCESS TO WORK

Owner and A/E access to Work site: Contractor shall provide Owner and A/E access to the Work in progress wherever located.

5.19 OTHER CONTRACTS

Owner may award other contracts; Contractor to cooperate: Owner may undertake or award other contracts for additional work at or near the Project site. Contractor shall reasonably cooperate with the other contractors and with Owner's employees and shall carefully adapt scheduling and perform the Work in accordance with these Contract Documents to reasonably accommodate the other work.

5.20 SUBCONTRACTORS AND SUPPLIERS

A. Subcontractor Responsibility: The Contractor shall include the language of this paragraph in each of its first tier subcontracts, and shall require each of its subcontractors to include the same language of this section in each of their subcontracts, adjusting only as necessary the terms used for the contracting parties. Upon request of the Owner, the Contractor shall promptly provide documentation to the Owner demonstrating that the subcontractor meets the subcontractor responsibility criteria below. The requirements of this paragraph apply to all subcontractors regardless of tier. At the time of subcontract execution, the Contractor shall verify that each of its first tier subcontractors meets the following bidder responsibility criteria:

1. Have a current certificate of registration as a contractor in compliance with chapter 18.27 RCW, which must have been in effect at the time of subcontract bid submittal;
2. Have a current Washington Unified Business Identifier (UBI) number;
3. If applicable, have:
 - a. Industrial Insurance (workers' compensation) coverage for the subcontractor's employees working in Washington, as required in Title 51 RCW;
 - b. A Washington Employment Security Department number, as required in Title 50 RCW;
 - c. A Washington Department of Revenue state excise tax registration number, as required in Title 82 RCW;
 - d. An electrical contractor license, if required by Chapter 19.28 RCW;
 - e. An elevator contractor license, if required by Chapter 70.87 RCW.
4. Not be disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065 (3).
5. On a project subject to the apprenticeship utilization requirements in RCW 39.04.320, not have been found out of compliance by the Washington state apprenticeship and training council for working apprentices out of ratio, without appropriate supervision, or outside their approved work processes as outlined in their standards of apprenticeship under chapter 49.04 RCW for the one-year period immediately preceding the date of the Owner's first advertisement of the project.

B. Provide names of Subcontractors for Payment, Contractor shall furnish numbers of all Subcontractors, and Contractor shall utilize Subcontractors that meet the requirements of the Contract. Subcontractor or supplier to whom Contractor shall obtain Owner's written consent before making

See Supplemental Conditions 5.20 which adds a new Paragraph A.6. and replaces General Conditions Section 5.20 B.

Application of telephone of \$2,500. qualified, and utilize any shall obtain

- C. Subcontracts in writing and pass through provision: All Subcontracts must be in writing. By appropriate written agreement, Contractor shall require each Subcontractor, so far as applicable to the Work to be performed by the Subcontractor, to be bound to Contractor by terms of the Contract Documents, and to assume toward Contractor all the obligations and responsibilities which Contractor assumes toward Owner in accordance with the Contract Documents. Each Subcontract shall preserve and protect the rights of Owner in accordance with the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights. Where appropriate, Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. However, nothing in this paragraph shall be construed to alter the contractual relations between Contractor and its Subcontractors with respect to insurance or bonds.
- D. Coordination of Subcontractors; Contractor responsible for Work: Contractor shall schedule, supervise, and coordinate the operations of all Subcontractors. No Subcontracting of any of the Work shall relieve Contractor from its responsibility for the performance of the Work in accordance with the Contract Documents or any other obligations of the Contract Documents.
- E. Automatic assignment of subcontracts: Each subcontract agreement for a portion of the Work is hereby assigned by Contractor to Owner provided that:
1. Effective only after termination and Owner approval: The assignment is effective only after termination by Owner for cause pursuant to Section 9.01 and only for those Subcontracts which Owner accepts by notifying the Subcontractor in writing; and
 2. Owner assumes Contractor's responsibilities: After the assignment is effective, Owner will assume all future duties and obligations toward the Subcontractor which Contractor assumed in the Subcontract.
 3. Impact of bond: The assignment is subject to the prior rights of the surety, if any, obligated under any bond provided in accordance with the Contract Documents.

5.21 WARRANTY OF CONSTRUCTION

- A. Contractor warranty of Work: In addition to any special warranties provided elsewhere in the Contract Documents, Contractor warrants that all Work conforms to the requirements of the Contract Documents and is free of any defect in equipment, material, or design furnished, or workmanship performed by Contractor.
- B. Contractor responsibilities: With respect to all warranties, express or implied, for Work performed or materials furnished according to the Contract Documents, Contractor shall:
1. Obtain warranties: Obtain all warranties that would be given in normal commercial practice;
 2. Warranties for benefit of Owner: Require all warranties to be executed, in writing, for the benefit of Owner;
 3. Enforcement of warranties: Enforce all warranties for the benefit of Owner, if directed by Owner; and
 4. Contractor responsibility for subcontractor warranties: Be responsible to enforce any subcontractor's, manufacturer's, or supplier's warranties should they extend beyond the period specified in the Contract Documents.
- C. Warranties beyond Final Acceptance: The obligations under this section shall survive Final Acceptance.

5.22 INDEMNIFICATION

- A. Contractor to indemnify Owner: Contractor shall defend, indemnify, and hold Owner and A/E harmless from and against all claims, demands, losses, damages, or costs, including but not limited to damages arising out of bodily injury or death to persons and damage to property, caused by or resulting from:
1. Sole negligence of Contractor: The sole negligence of Contractor or any of its Subcontractors;
 2. Concurrent negligence: The concurrent negligence of Contractor, or any Subcontractor, but only to the extent of the negligence of Contractor or such Subcontractor; and
 3. Patent infringement: The use of any design, process, or equipment which constitutes an infringement of any United States patent presently issued, or violates any other proprietary interest, including copyright, trademark, and trade secret.
- B. Employee action and RCW Title 51: In any action against Owner and any other entity indemnified in accordance with this section, by any employee of Contractor, its Subcontractors, Sub-subcontractors, agents, or anyone directly or indirectly employed by any of them, the indemnification obligation of this section shall not be limited by a limit on the amount or type of damages, compensation, or benefits payable by or for Contractor or any Subcontractor under RCW Title 51, the Industrial Insurance Act, or any other employee benefit acts. In addition, Contractor waives immunity as to Owner and A/E only, in accordance with RCW Title 51.

PART 6 – PAYMENTS AND COMPLETION

6.01 CONTRACT SUM

Owner shall pay Contract Sum: Owner shall pay Contractor the Contract Sum plus state sales tax for performance of the Work, in accordance with the Contract Documents.

6.02 SCHEDULE OF VALUES

Contractor to submit Schedule of Values: Before submitting its first Application for Payment, Contractor shall submit to Owner for approval a breakdown allocating the total Contract Sum to each principal category of work, in such detail as requested by Owner (“Schedule of Values”). The approved Schedule of Values shall include appropriate amounts for demobilization, record drawings, O&M manuals, and any other requirements for Project closeout, and shall be used by Owner as the basis for progress payments. Payment for Work shall be made only for and in accordance with those items included in the Schedule of Values.

6.03 APPLICATION FOR PAYMENT

- A. Monthly Application for Payment with substantiation: At monthly intervals, unless determined otherwise by Owner, Contractor shall submit to Owner an itemized Application for Payment for Work completed in accordance with the Contract Documents and the approved Schedule of Values. Each application shall be supported by such substantiating data as Owner may require.
- B. Contractor certifies Subcontractors paid: By submitting an Application for Payment, Contractor is certifying that all Subcontractors have been paid, less earned retainage in accordance with RCW 60.28.011, as their interests appeared in the last preceding certificate of payment. By submitting an Application for Payment, Contractor is recertifying that the representations set forth in Section 1.03, are true and correct, to the best of Contractor’s knowledge, as of the date of the Application for Payment.

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- C. Reconciliation of Work with Progress Schedule: At the time it submits an Application for Payment, Contractor shall analyze and reconcile, to the satisfaction of Owner, the actual progress of the Work with the Progress Schedule.
- D. Payment for material delivered to site or stored off-site: If authorized by Owner, the Application for Payment may include request for payment for material delivered to the Project site and suitably stored, or for completed preparatory work. Payment may similarly be requested for material stored off the Project site, provided Contractor complies with or furnishes satisfactory evidence of the following:
1. Suitable facility or location: The material will be placed in a facility or location that is structurally sound, dry, lighted and suitable for the materials to be stored;
 2. Facility or location within 10 miles of Project: The facility or location is located within a 10-mile radius of the Project. Other locations may be utilized, if approved in writing, by Owner;
 3. Facility or location exclusive to Project's materials: Only materials for the Project are stored within the facility or location (or a secure portion of a facility or location set aside for the Project);
 4. Insurance provided on materials in facility or location: Contractor furnishes Owner a certificate of insurance extending Contractor's insurance coverage for damage, fire, and theft to cover the full value of all materials stored, or in transit;
 5. Facility or location locked and secure: The facility or location (or secure portion thereof) is continuously under lock and key, and only Contractor's authorized personnel shall have access;
 6. Owner right of access to facility or location: Owner shall at all times have the right of access in company of Contractor;
 7. Contractor assumes total responsibility for stored materials: Contractor and its surety assume total responsibility for the stored materials; and
 8. Contractor provides documentation and Notice when materials moved to site: Contractor furnishes to Owner certified lists of materials stored, bills of lading, invoices, and other information as may be required, and shall also furnish Notice to Owner when materials are moved from storage to the Project site.

6.04 PROGRESS PAYMENTS

- A. Owner to pay within 30 Days: Owner shall make progress payments, in such amounts as Owner determines are properly due, within 30 Days after receipt of a properly executed Application for Payment. Owner shall notify Contractor in accordance with chapter 39.76 RCW if the Application for Payment does not comply with the requirements of the Contract Documents.
- B. Withholding retainage; Options for retainage: Owner shall retain 5% of the amount of each progress payment until 45 Days after Final Acceptance and receipt of all documents required by law or the Contract Documents, including, at Owner's request, consent of surety to release of the retainage. In accordance with chapter 60.28 RCW, Contractor may request that monies reserved be retained in a fund by Owner, deposited by Owner in a bank or savings and loan, or placed in escrow with a bank or trust company to be converted into bonds and securities to be held in escrow with interest to be paid to Contractor. Owner may permit Contractor to provide an appropriate bond in lieu of the retained funds.

- C. Title passes to Owner upon payment: Title to all Work and materials covered by a progress payment shall pass to Owner at the time of such payment free and clear of all liens, claims, security interests, and encumbrances. Passage of title shall not, however, relieve Contractor from any of its duties and responsibilities for the Work or materials, or waive any rights of Owner to insist on full compliance by Contractor with the Contract Documents.
- D. Interest on unpaid balances: Payments due and unpaid in accordance with the Contract Documents shall bear interest as specified in chapter 39.76 RCW.

6.05 PAYMENTS WITHHELD

- A. Owner's right to withhold payment: Owner may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any payment to such extent as may be necessary to protect Owner from loss or damage for reasons including but not limited to:
1. Non-compliant Work: Work not in accordance with the Contract Documents;
 2. Remaining Work to cost more than unpaid balance: Reasonable evidence that the Work required by the Contract Documents cannot be completed for the unpaid balance of the Contract Sum;
 3. Owner correction or completion Work: Work by Owner to correct defective Work or complete the Work in accordance with Section 5.16;
 4. Contractor's failure to perform: Contractor's failure to perform in accordance with the Contract Documents; or
 5. Contractor's negligent acts or omissions: Cost or liability that may occur to Owner as the result of Contractor's fault or negligent acts or omissions.
- B. Owner to notify Contractor of withholding for unsatisfactory performance: In any case where part or all of a payment is going to be withheld for unsatisfactory performance, Owner shall notify Contractor in accordance with chapter 39.76 RCW.

6.06 RETAINAGE AND BOND CLAIM RIGHTS

Chapters 39.08 RCW and 60.28 RCW incorporated by reference: Chapters 39.08 RCW and 60.28 RCW, concerning the rights and responsibilities of Contractor and Owner with regard to the performance and payment bonds and retainage, are made a part of the Contract Documents by reference as though fully set forth herein.

6.07 SUBSTANTIAL COMPLETION

Substantial Completion defined: Substantial Completion is the stage in the progress of the Work (or portion thereof designated and approved by Owner) when the construction is sufficiently complete, in accordance with the Contract Documents, so Owner has full and unrestricted use and benefit of the facilities (or portion thereof designated and approved by Owner) for the use for which it is intended. All Work other than incidental corrective or punch list work shall be completed. Substantial Completion shall not have been achieved if all systems and parts are not functional, if utilities are not connected and operating normally, if all required occupancy permits have not been issued, or if the Work is not accessible by normal vehicular and pedestrian traffic routes. The date Substantial Completion is achieved shall be established in writing by Owner. Contractor may request an early date of Substantial Completion which must be approved by Change Order. Owner's occupancy of the Work or designated portion thereof does not necessarily indicate that Substantial Completion has been achieved.

6.08 PRIOR OCCUPANCY

- A. Prior Occupancy defined; Restrictions: Owner may, upon written notice thereof to Contractor, take possession of or use any completed or partially completed portion of the Work ("Prior Occupancy") at any time prior to Substantial Completion. Unless otherwise agreed in writing, Prior Occupancy shall not: be deemed an acceptance of any portion of the Work; accelerate the time for any payment to Contractor; prejudice any rights of Owner provided by any insurance, bond, guaranty, or the Contract Documents; relieve Contractor of the risk of loss or any of the obligations established by the Contract Documents; establish a date for termination or partial termination of the assessment of liquidated damages; or constitute a waiver of claims.
- B. Damage; Duty to repair and warranties: Notwithstanding anything in the preceding paragraph, Owner shall be responsible for loss of or damage to the Work resulting from Prior Occupancy. Contractor's one year duty to repair any system warranties shall begin on building systems activated and used by Owner as agreed in writing by Owner and Contractor.

6.09 FINAL COMPLETION, ACCEPTANCE, AND PAYMENT

- A. Final Completion defined: Final Completion shall be achieved when the Work is fully and finally complete in accordance with the Contract Documents. The date Final Completion is achieved shall be established by Owner in writing, but in no case shall constitute Final Acceptance which is a subsequent, separate, and distinct action.
- B. Final Acceptance defined: Final Acceptance shall be achieved when the Contractor has completed the requirements of the Contract Documents. The date Final Acceptance is achieved shall be established by Owner in writing. Prior to Final Acceptance, Contractor shall, in addition to all other requirements in the Contract Documents, submit to Owner a written notice of any outstanding disputes or claims between Contractor and any of its Subcontractors, including the amounts and other details thereof. Neither Final Acceptance, nor final payment, shall release Contractor or its sureties from any obligations of these Contract Documents or the payment and performance bonds, or constitute a waiver of any claims by Owner arising from Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Final payment waives Claim rights: Acceptance of final payment by Contractor, or any Subcontractor, shall constitute a waiver and release to Owner of all claims by Contractor, or any such Subcontractor, for an increase in the Contract Sum or the Contract Time, and for every act or omission of Owner relating to or arising out of the Work, except for those Claims made in accordance with the procedures, including the time limits, set forth in Part 8.

PART 7 – CHANGES

7.01 CHANGE IN THE WORK

- A. Changes in Work, Contract Sum, and Contract Time by Change Order: Owner may, at any time and without notice to Contractor's surety, order additions, deletions, revisions, or other changes in the Work. These changes in the Work shall be incorporated into the Contract Documents through the execution of Change Orders. If any change in the Work ordered by Owner causes an increase or decrease in the Contract Sum or the Contract Time, an equitable adjustment shall be made as provided in Section 7.02 or 7.03, respectively, and such adjustment(s) shall be incorporated into a Change Order.
- B. Owner may request COP from Contractor: If Owner desires to order a change in the Work, it may request a written Change Order Proposal (COP) from Contractor. Contractor shall submit a Change Order Proposal within 14 Days of the request from Owner, or within such other period as mutually agreed. Contractor's Change Order Proposal shall be full compensation for

implementing the proposed change in the Work, including any adjustment in the Contract Sum or Contract Time, and including compensation for all delays in connection with such change in the Work and for any expense or inconvenience, disruption of schedule, or loss of efficiency or productivity occasioned by the change in the Work.

- C. COP negotiations: Upon receipt of the Change Order Proposal, or a request for equitable adjustment in the Contract Sum or Contract Time, or both, as provided in Sections 7.02 and 7.03, Owner may accept or reject the proposal, request further documentation, or negotiate acceptable terms with Contractor. Pending agreement on the terms of the Change Order, Owner may direct Contractor to proceed immediately with the Change Order Work. Contractor shall not proceed with any change in the Work until it has obtained Owner's approval. All Work done pursuant to any Owner-directed change in the Work shall be executed in accordance with the Contract Documents.
- D. Change Order as full payment and final settlement: If Owner and Contractor reach agreement on the terms of any change in the Work, including any adjustment in the Contract Sum or Contract Time, such agreement shall be incorporated in a Change Order. The Change Order shall constitute full payment and final settlement of all claims for time and for direct, indirect, and consequential costs, including costs of delays, inconvenience, disruption of schedule, or loss of efficiency or productivity, related to any Work either covered or affected by the Change Order, or related to the events giving rise to the request for equitable adjustment.
- E. Failure to agree upon terms of Change Order; Final offer and Claims: If Owner and Contractor are unable to reach agreement on the terms of any change in the Work, including any adjustment in the Contract Sum or Contract Time, Contractor may at any time in writing, request a final offer from Owner. Owner shall provide Contractor with its written response within 30 Days of Contractor's request. Owner may also provide Contractor with a final offer at any time. If Contractor rejects Owner's final offer, or the parties are otherwise unable to reach agreement, Contractor's only remedy shall be to file a Claim as provided in Part 8.
- F. Field Authorizations: The Owner may direct the Contractor to proceed with a change in the work through a written Field Authorization (also referred to as a Field Order) when the time required to price and execute a Change Order would impact the Project.

The Field Authorization shall describe and include the following:

1. The scope of work
2. An agreed upon maximum not-to-exceed amount
3. Any estimated change to the Contract Time
4. The method of final cost determination in accordance with the requirements of Part 7 of the General Conditions
5. The supporting cost data to be submitted in accordance with the requirements of Part 7 of the General Conditions

Upon satisfactory submittal by the Contractor and approval by the Owner of supporting cost data, a Change Order will be executed. The Owner will not make payment to the Contractor for Field Authorization work until that work has been incorporated into an executed Change Order.

7.02 CHANGE IN THE CONTRACT SUM

A. General Application

1. Contract Sum changes only by Change Order: The Contract Sum shall only be changed by a Change Order. Contractor shall include any request for a change in the Contract Sum in its Change Order Proposal.

2. Owner fault or negligence as basis for change in Contract Sum: If the cost of Contractor's performance is changed due to the fault or negligence of Owner, or anyone for whose acts Owner is responsible, Contractor shall be entitled to make a request for an equitable adjustment in the Contract Sum in accordance with the following procedure. No change in the Contract Sum shall be allowed to the extent: Contractor's changed cost of performance is due to the fault or negligence of Contractor, or anyone for whose acts Contractor is responsible; the change is concurrently caused by Contractor and Owner; or the change is caused by an act of Force Majeure as defined in Section 3.05.
 - (a) Notice and record keeping for equitable adjustment: A request for an equitable adjustment in the Contract Sum shall be based on written notice delivered to Owner within 7 Days of the occurrence of the event giving rise to the request. For purposes of this part, "occurrence" means when Contractor knew, or in its diligent prosecution of the Work should have known, of the event giving rise to the request. If Contractor believes it is entitled to an adjustment in the Contract Sum, Contractor shall immediately notify Owner and begin to keep and maintain complete, accurate, and specific daily records. Contractor shall give Owner access to any such records and, if requested shall promptly furnish copies of such records to Owner.

 - (b) Content of notice for equitable adjustment; Failure to comply: Contractor shall not be entitled to any adjustment in the Contract Sum for any occurrence of events or costs that occurred more than 7 Days before Contractor's written notice to Owner. The written notice shall set forth, at a minimum, a description of: the event giving rise to the request for an equitable adjustment in the Contract Sum; the nature of the impacts to Contractor and its Subcontractors of any tier, if any; and to the extent possible the amount of the adjustment in Contract Sum requested. Failure to properly give such written notice shall, to the extent Owner's interests are prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.

 - (c) Contractor to provide supplemental information: Within 30 Days of the occurrence of the event giving rise to the request, unless Owner agrees in writing to allow an additional period of time to ascertain more accurate data, Contractor shall supplement the written notice provided in accordance with subparagraph a. above with additional supporting data. Such additional data shall include, at a minimum: the amount of compensation requested, itemized in accordance with the procedure set forth herein; specific facts, circumstances, and analysis that confirms not only that Contractor suffered the damages claimed, but that the damages claimed were actually a result of the act, event, or condition complained of and that the Contract Documents provide entitlement to an equitable adjustment to Contractor for such act, event, or condition; and documentation sufficiently detailed to permit an informed analysis of the request by Owner. When the request for compensation relates to a delay, or other change in Contract Time, Contractor shall demonstrate the impact on the critical path, in accordance with Section 7.03C. Failure to provide such additional information and documentation within the time allowed or within the format required shall, to the extent Owner's interests are prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.

- (d) Contractor to proceed with Work as directed: Pending final resolution of any request made in accordance with this paragraph, unless otherwise agreed in writing, Contractor shall proceed diligently with performance of the Work.
 - (e) Contractor to combine requests for same event together: Any requests by Contractor for an equitable adjustment in the Contract Sum and in the Contract Time that arise out of the same event(s) shall be submitted together.
3. Methods for calculating Change Order amount: The value of any Work covered by a Change Order, or of any request for an equitable adjustment in the Contract Sum, shall be determined by one of the following methods:
- a. Fixed Price: On the basis of a fixed price as determined in paragraph 7.02B.
 - b. Unit Prices: By application of unit prices to the quantities of the items involved as determined in paragraph 7.02C.
 - c. Time and Materials: On the basis of time and material as determined in paragraph 7.02D.
4. Fixed price method is default; Owner may direct otherwise: When Owner has requested Contractor to submit a Change Order Proposal, Owner may direct Contractor as to which method in subparagraph 3 above to use when submitting its proposal. Otherwise, Contractor shall determine the value of the Work, or of a request for an equitable adjustment, on the basis of the fixed price method.

B. Change Order Pricing – Fixed Price

Procedures: When the fixed price method is used to determine the value of any Work covered by a Change Order, or of a request for an equitable adjustment in the Contract Sum, the following procedures shall apply:

- 1. Breakdown and itemization of details on COP: Contractor's Change Order Proposal, or request for adjustment in the Contract Sum, shall be accompanied by a complete itemization of the costs, including labor, material, subcontractor costs, and overhead and profit. The costs shall be itemized in the manner set forth below, and shall be submitted on breakdown sheets in a form approved by Owner.
- 2. Use of industry standards in calculating costs: All costs shall be calculated based upon appropriate industry standard methods of calculating labor, material quantities, and equipment costs.
- 3. Costs contingent on Owner's actions: If any of Contractor's pricing assumptions are contingent upon anticipated actions of Owner, Contractor shall clearly state them in the proposal or request for an equitable adjustment.
- 4. Markups on additive and deductive Work: The cost of any additive or deductive changes in the Work shall be calculated as set forth below, except that overhead and profit shall not be included on deductive changes in the Work. Where a change in the Work involves additive and deductive work by the same Contractor or Subcontractor, small tools, overhead, profit, bond and insurance markups will apply to the net difference.
- 5. Breakdown not required if change less than \$1,000: If the total cost of the change in the Work or request for equitable adjustment does not exceed \$1,000, Contractor shall not be required to submit a breakdown if the description of the change in the Work or request for equitable adjustment is sufficiently definitive for Owner to determine fair value.

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6. Breakdown required if change between \$1,000 and \$2,500: If the total cost of the change in the Work or request for equitable adjustment is between \$1,000 and \$2,500, Contractor may submit a breakdown in the following level of detail if the description of the change in the Work or if the request for equitable adjustment is sufficiently definitive to permit the Owner to determine fair value:
- a. lump sum labor;
 - b. lump sum material;
 - c. lump sum equipment usage;
 - d. overhead and profit as set forth below; and
 - e. insurance and bond costs as set forth below.
7. Components of increased cost: Any request for adjustment of Contract Sum based upon the fixed price method shall include only the following items:
- a. Craft labor costs: These are the labor costs determined by multiplying the estimated or actual additional number of craft hours needed to perform the change in the Work by the hourly labor costs. Craft hours should cover direct labor, as well as indirect labor due to trade inefficiencies. The hourly costs shall be based on the following:
 - (1) Basic wages and benefits: Hourly rates and benefits as stated on the Department of Labor and Industries approved "statement of intent to pay prevailing wages" or a higher amount if approved by the Owner. Direct supervision shall be a reasonable percentage not to exceed 15% of the cost of direct labor. No supervision markup shall be allowed for a working supervisor's hours.
 - (2) Worker's insurance: Direct contributions to the state of Washington for industrial insurance; medical aid; and supplemental pension, by the class and rates established by the Department of Labor and Industries.
 - (3) Federal insurance: Direct contributions required by the Federal Insurance Compensation Act; Federal Unemployment Tax Act; and the State Unemployment Compensation Act.
 - (4) Travel allowance: Travel allowance and/or subsistence, if applicable, not exceeding those allowances established by regional labor union agreements, which are itemized and identified separately.
 - (5) Safety: Cost incurred due to the Washington Industrial Safety and Health Act, which shall be a reasonable percentage not to exceed 2% of the sum of the amounts calculated in (1), (2), and (3) above.
 - b. Material costs: This is an itemization of the quantity and cost of materials needed to perform the change in the Work. Material costs shall be developed first from actual known costs, second from supplier quotations or if these are not available, from standard industry pricing guides. Material costs shall consider all available discounts. Freight costs, express charges, or special delivery charges, shall be itemized.

c. Equipment costs: See Supplemental Conditions 7.02 and the estimated or actual for the Work is or will be used for the construction equipment rental costs actually computed on the basis of the current edition of one of the following:

(1)	Associated Transportation edition, on the	ent of current
(2)	The National electrical work	sed on
(3)	The Mechanical on mechanical	nt used

The EquipmentWatch Rental rates of equipment not on the equipment shall not exceed the Agreement, current edition of the Watch Rental

d. Allowance for small tools, expendables & consumable supplies: Small tools consist of tools which cost \$250 or less and are normally furnished by the performing contractor. The maximum rate for small tools shall not exceed the following:

- (1) 3% for Contractor: For Contractor, 3% of direct labor costs.
- (2) 5% for Subcontractors: For Subcontractors, 5% of direct labor costs.

Expendables and consumables supplies directly associated with the change in Work must be itemized.

e. Subcontractor costs: This is defined as payments Contractor makes to Subcontractors for changed Work performed by Subcontractors of any tier. The Subcontractors' cost of Work shall be calculated and itemized in the same manner as prescribed herein for Contractor.

f. Allowance for overhead: This is defined as costs of any kind attributable to direct and indirect delay, acceleration, or impact, added to the total cost to Owner of any change in the Contract Sum. If the Contractor is compensated under Section 7.03D, the amount of such compensation shall be reduced by the amount Contractor is otherwise entitled to under this subsection (f). This allowance shall compensate Contractor for all noncraft labor, temporary construction facilities, field engineering, schedule updating, as-built drawings, home office cost, B&O taxes, office engineering, estimating costs, additional overhead because of extended time, and any other cost incidental to the change in the Work. It shall be strictly limited in all cases to a reasonable amount, mutually acceptable, or if none can be agreed upon to an amount not to exceed the rates below:

- (1) Projects less than \$3 million: For projects where the Contract Award Amount is under \$3 million, the following shall apply:

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- (a) Contractor markup on Contractor Work: For Contractor, for any Work actually performed by Contractor's own forces, 16% of the first \$50,000 of the cost, and 4% of the remaining cost, if any.
 - (b) Subcontractor markup for Subcontractor Work: For each Subcontractor (including lower tier subcontractors), for any Work actually performed by its own forces, 16% of the first \$50,000 of the cost, and 4% of the remaining cost, if any.
 - (c) Contractor markup for Subcontractor Work: For Contractor, for any work performed by its Subcontractor(s) 6% of the first \$50,000 of the amount due each Subcontractor, and 4% of the remaining amount if any.
 - (d) Subcontractor markup for lower tier Subcontractor Work: For each Subcontractor, for any Work performed by its Subcontractor(s) of any lower tier, 4% of the first \$50,000 of the amount due the sub-Subcontractor, and 2% of the remaining amount if any.
 - (e) Basis of cost applicable for markup: The cost to which overhead is to be applied shall be developed in accordance with Section 7.02B 7a. – e.
- (2). Projects more than \$3 million: For projects where the Contract Award Amount is equal to or exceeds \$3 million, the following shall apply:
- (a) Contractor markup on Contractor Work: For Contractor, for any Work actually performed by Contractor's own forces, 12% of the first \$50,000 of the cost, and 4% of the remaining cost, if any.
 - (b) Subcontractor markup for Subcontractor Work: For each Subcontractor (including lower tier subcontractors), for any Work actually performed by its own forces, 12% of the first \$50,000 of the cost, and 4% of the remaining cost, if any.
 - (c) Contractor markup for Subcontractor Work: For Contractor, for any Work performed by its Subcontractor(s), 4% of the first \$50,000 of the amount due each Subcontractor, and 2% of the remaining amount if any.
 - (d) Subcontractor markup for lower tier Subcontractor Work: For each Subcontractor, for any Work performed by its Subcontractor(s) of any lower tier, 4% of the first \$50,000 of the amount due the sub-Subcontractor, and 2% of the remaining amount if any.
 - (e) Basis of cost applicable for markup: The cost to which overhead is to be applied shall be developed in accordance with Section 7.02B 7a. – e.
- g. Allowance for profit: Allowance for profit is an amount to be added to the cost of any change in contract sum, but not to the cost of change in Contract Time for which contractor has been compensated pursuant to the conditions set forth in Section 7.03. It shall be limited to a reasonable amount, mutually acceptable, or if none can be agreed upon, to an amount not to exceed the rates below:
- (1) Contractor / Subcontractor markup for self-performed Work: For Contractor or Subcontractor of any tier for work performed by their forces, 6% of the cost developed in accordance with Section 7.02B 7a. – e.

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- (2) Contractor / Subcontractor markup for Work performed at lower tier: For Contractor or Subcontractor of any tier for work performed by a subcontractor of a lower tier, 4% of the subcontract cost developed in accordance with Section 7.02B 7a. – h.
- h. Insurance and bond premiums: Cost of change in insurance or bond premium: This is defined as:
 - (1) Contractor's liability insurance: The cost of any changes in Contractor's liability insurance arising directly from execution of the Change Order; and
 - (2) Payment and Performance Bond: The cost of the additional premium for Contractor's bond arising directly from the changed Work.

The cost of any change in insurance or bond premium shall be added after overhead and allowance for profit are calculated in accordance with subparagraph f. and g above.

C. Change Order Pricing – Unit Prices

- 1. Content of Owner authorization: Whenever Owner authorizes Contractor to perform Work on a unit-price basis, Owner's authorization shall clearly state:
 - a. Scope: Scope of work to be performed;
 - b. Reimbursement basis: Type of reimbursement including pre-agreed rates for material quantities; and
 - c. Reimbursement limit: Cost limit of reimbursement.
- 2. Contractor responsibilities: Contractor shall:
 - a. Cooperate with Owner and assist in monitoring the Work being performed. As requested by Owner, Contractor shall identify workers assigned to the Change Order Work and areas in which they are working;
 - b. Leave access as appropriate for quantity measurement; and
 - c. Not exceed any cost limit(s) without Owner's prior written approval.
- 3. Cost breakdown consistent with Fixed Price requirements: Contractor shall submit costs in accordance with paragraph 7.02B and satisfy the following requirements:
 - a. Unit prices must include overhead, profit, bond and insurance premiums: Unit prices shall include reimbursement for all direct and indirect costs of the Work, including overhead, profit, bond, and insurance costs; and
 - b. Owner verification of quantities: Quantities must be supported by field measurement statements signed by Owner.

D. Change Order Pricing – Time-and-Material Prices

- 1. Content of Owner authorization: Whenever Owner authorizes Contractor to perform Work on a time-and-material basis, Owner's authorization shall clearly state:
 - a. Scope: Scope of Work to be performed;

- b. Reimbursement basis: Type of reimbursement including pre-agreed rates, if any, for material quantities or labor; and
 - c. Reimbursement limit: Cost limit of reimbursement.
2. Contractor responsibilities: Contractor shall:
- a. Identify workers assigned: Cooperate with Owner and assist in monitoring the Work being performed. As requested by Owner, identify workers assigned to the Change Order Work and areas in which they are working;
 - b. Provide daily timesheets: Identify on daily time sheets all labor performed in accordance with this authorization. Submit copies of daily time sheets within 2 working days for Owner's review.
 - c. Allow Owner to measure quantities: Leave access as appropriate for quantity measurement;
 - d. Perform Work efficiently: Perform all Work in accordance with this section as efficiently as possible; and
 - e. Not exceed Owner's cost limit: Not exceed any cost limit(s) without Owner's prior written approval.
3. Cost breakdown consistent with Fixed Price requirements: Contractor shall submit costs in accordance with paragraph 7.02B and additional verification supported by:
- a. Timesheets: Labor detailed on daily time sheets; and
 - b. Invoices: Invoices for material.

7.03 CHANGE IN THE CONTRACT TIME

- A. COP requests for Contract Time: The Contract Time shall only be changed by a Change Order. Contractor shall include any request for a change in the Contract Time in its Change Order Proposal.
- B. Time extension permitted if not Contractor's fault: If the time of Contractor's performance is changed due to an act of Force Majeure, or due to the fault or negligence of Owner or anyone for whose acts Owner is responsible, Contractor shall be entitled to make a request for an equitable adjustment in the Contract Time in accordance with the following procedure. No adjustment in the Contract Time shall be allowed to the extent Contractor's changed time of performance is due to the fault or negligence of Contractor, or anyone for whose acts Contractor is responsible.
- 1. Notice and record keeping for Contract Time request: A request for an equitable adjustment in the Contract Time shall be based on written notice delivered within 7 Days of the occurrence of the event giving rise to the request. If Contractor believes it is entitled to adjustment of Contract Time, Contractor shall immediately notify Owner and begin to keep and maintain complete, accurate, and specific daily records. Contractor shall give Owner access to any such record and if requested, shall promptly furnish copies of such record to Owner.
 - 2. Timing and content of Contractor's Notice: Contractor shall not be entitled to an adjustment in the Contract Time for any events that occurred more than 7 Days before Contractor's written notice to Owner. The written notice shall set forth, at a minimum, a description of: the event giving rise to the request for an equitable adjustment in the

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Contract Time; the nature of the impacts to Contractor and its Subcontractors of any tier, if any; and to the extent possible the amount of the adjustment in Contract Time requested. Failure to properly give such written notice shall, to the extent Owner's interests are prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.

3. Contractor to provide supplemental information: Within 30 Days of the occurrence of the event giving rise to the request, unless Owner agrees in writing to allow an additional period of time to ascertain more accurate data, Contractor shall supplement the written notice provided in accordance with subparagraph 7.03B.2 with additional supporting data. Such additional data shall include, at a minimum: the amount of delay claimed, itemized in accordance with the procedure set forth herein; specific facts, circumstances, and analysis that confirms not only that Contractor suffered the delay claimed, but that the delay claimed was actually a result of the act, event, or condition complained of, and that the Contract Documents provide entitlement to an equitable adjustment in Contract Time for such act, event, or condition; and supporting documentation sufficiently detailed to permit an informed analysis of the request by Owner. Failure to provide such additional information and documentation within the time allowed or within the format required shall, to the extent Owner's interests are prejudiced, constitute a waiver of Contractor's right to an equitable adjustment.
 4. Contractor to proceed with Work as directed: Pending final resolution of any request in accordance with this paragraph, unless otherwise agreed in writing, Contractor shall proceed diligently with performance of the Work.
- C. Contractor to demonstrate impact on critical path of schedule: Any change in the Contract Time covered by a Change Order, or based on a request for an equitable adjustment in the Contract Time, shall be limited to the change in the critical path of Contractor's schedule attributable to the change of Work or event(s) giving rise to the request for equitable adjustment. Any Change Order Proposal or request for an adjustment in the Contract Time shall demonstrate the impact on the critical path of the schedule. Contractor shall be responsible for showing clearly on the Progress Schedule that the change or event: had a specific impact on the critical path, and except in case of concurrent delay, was the sole cause of such impact; and could not have been avoided by resequencing of the Work or other reasonable alternatives.
- D. Cost of change in Contract Time: Contractor may request compensation for the cost of a change in Contract Time in accordance with this paragraph, 7.03D, subject to the following conditions:
1. Must be solely fault of Owner or A/E: The change in Contract Time shall solely be caused by the fault or negligence of Owner or A/E;
 2. Procedures: Contractor shall follow the procedure set forth in paragraph 7.03B;
 3. Demonstrate impact on critical path: Contractor shall establish the extent of the change in Contract Time in accordance with paragraph 7.03C; and
 4. Limitations on daily costs: The daily cost of any change in Contract Time shall be limited to the items below, less the amount of any change in the Contract Sum the Contractor may otherwise be entitled to pursuant to Section 7.02B 7f for any change in the Work that contributed to this change in Contract Time:
 - a. Non-productive supervision or labor: cost of nonproductive field supervision or labor extended because of delay;
 - b. Weekly meetings and indirect activities: cost of weekly meetings or similar indirect activities extended because of the delay;

- c. Temporary facilities or equipment rental: cost of temporary facilities or equipment rental extended because of the delay;
- d. Insurance premiums: cost of insurance extended because of the delay;
- e. Overhead: general and administrative overhead in an amount to be agreed upon, but not to exceed 3% of the Contract Award Amount divided by the originally specified Contract Time for each Day of the delay.

PART 8 – CLAIMS AND DISPUTE RESOLUTION

8.01 CLAIMS PROCEDURE

- A. Claim is Contractor's remedy: If the parties fail to reach agreement on the terms of any Change Order for Owner-directed Work as provided in Section 7.01, or on the resolution of any request for an equitable adjustment in the Contract Sum as provided in Section 7.02 or the Contract Time as provided in Section 7.03, Contractor's only remedy shall be to file a Claim with Owner as provided in this section.
- B. Claim filing deadline for Contractor: Contractor shall file its Claim within 120 Days from Owner's final offer made in accordance with paragraph 7.01E, or by the date of Final Acceptance, whichever occurs first.
- C. Claim must cover all costs and be documented: The Claim shall be deemed to cover all changes in cost and time (including direct, indirect, impact, and consequential) to which Contractor may be entitled. It shall be fully substantiated and documented. At a minimum, the Claim shall contain the following information:
 - 1. Factual statement of Claim: A detailed factual statement of the Claim for additional compensation and time, if any, providing all necessary dates, locations, and items of Work affected by the Claim;
 - 2. Dates: The date on which facts arose which gave rise to the Claim;
 - 3. Owner and A/E employee's knowledgeable about Claim: The name of each employee of Owner or A/E knowledgeable about the Claim;
 - 4. Support from Contract Documents: The specific provisions of the Contract Documents which support the Claim;
 - 5. Identification of other supporting information: The identification of any documents and the substance of any oral communications that support the Claim;
 - 6. Copies of supporting documentation: Copies of any identified documents, other than the Contract Documents, that support the Claim;
 - 7. Details on Claim for Contract Time: If an adjustment in the Contract Time is sought: the specific days and dates for which it is sought; the specific reasons Contractor believes an extension in the Contract Time should be granted; and Contractor's analysis of its Progress Schedule to demonstrate the reason for the extension in Contract Time;
 - 8. Details on Claim for adjustment of Contract Sum: If an adjustment in the Contract Sum is sought, the exact amount sought and a breakdown of that amount into the categories set forth in, and in the detail as required by Section 7.02; and

9. Statement certifying Claim: A statement certifying, under penalty of perjury, that the Claim is made in good faith, that the supporting cost and pricing data are true and accurate to the best of Contractor's knowledge and belief, that the Claim is fully supported by the accompanying data, and that the amount requested accurately reflects the adjustment in the Contract Sum or Contract Time for which Contractor believes Owner is liable.
- D. Owner's response to Claim filed: After Contractor has submitted a fully documented Claim that complies with all applicable provisions of Parts 7 and 8, Owner shall respond, in writing, to Contractor as follows:
1. Response time for Claim less than \$50,000: If the Claim amount is less than \$50,000, with a decision within 60 Days from the date the Claim is received; or
 2. Response time for Claim of \$50,000 or more: If the Claim amount is \$50,000 or more, with a decision within 60 Days from the date the Claim is received, or with notice to Contractor of the date by which it will render its decision. Owner will then respond with a written decision in such additional time.
- E. Owner's review of Claim and finality of decision: To assist in the review of Contractor's Claim, Owner may visit the Project site, or request additional information, in order to fully evaluate the issues raised by the Claim. Contractor shall proceed with performance of the Work pending final resolution of any Claim. Owner's written decision as set forth above shall be final and conclusive as to all matters set forth in the Claim, unless Contractor follows the procedure set forth in Section 8.02.
- F. Waiver of Contractor rights for failure to comply with this Section: Any Claim of the Contractor against the Owner for damages, additional compensation, or additional time, shall be conclusively deemed to have been waived by the Contractor unless made in accordance with the requirements of this Section.

8.02 ARBITRATION

- A. Timing of Contractor's demand for arbitration: If Contractor disagrees with Owner's decision rendered in accordance with paragraph 8.01D, Contractor shall provide Owner with a written demand for arbitration. No demand for arbitration of any such Claim shall be made later than 30 Days after the date of Owner's decision on such Claim; failure to demand arbitration within said 30 Day period shall result in Owner's decision being final and binding upon Contractor and its Subcontractors.
- B. Filing of Notice for arbitration: Notice of the demand for arbitration shall be filed with the American Arbitration Association (AAA), with a copy provided to Owner. The parties shall negotiate or mediate under the Voluntary Construction Mediation Rules of the AAA, or mutually acceptable service, before seeking arbitration in accordance with the Construction Industry Arbitration Rules of AAA as follows:
1. Claims less than \$30,000: Disputes involving \$30,000 or less shall be conducted in accordance with the Northwest Region Expedited Commercial Arbitration Rules; or
 2. Claims greater than \$30,000: Disputes over \$30,000 shall be conducted in accordance with the Construction Industry Arbitration Rules of the AAA, unless the parties agree to use the expedited rules.
- C. Arbitration is forum for resolving Claims: All Claims arising out of the Work shall be resolved by arbitration. The judgment upon the arbitration award may be entered, or review of the award may

occur, in the superior court having jurisdiction thereof. No independent legal action relating to or arising from the Work shall be maintained.

- D. Owner may combine Claims into same arbitration: Claims between Owner and Contractor, Contractor and its Subcontractors, Contractor and A/E, and Owner and A/E shall, upon demand by Owner, be submitted in the same arbitration or mediation.
- E. Settlement outside of arbitration to be documented in Change Order: If the parties resolve the Claim prior to arbitration judgment, the terms of the resolution shall be incorporated in a Change Order. The Change Order shall constitute full payment and final settlement of the Claim, including all claims for time and for direct, indirect, or consequential costs, including costs of delays, inconvenience, disruption of schedule, or loss of efficiency or productivity.

8.03 CLAIMS AUDITS

- A. Owner may audit Claims: All Claims filed against Owner shall be subject to audit at any time following the filing of the Claim. Failure of Contractor, or Subcontractors of any tier, to maintain and retain sufficient records to allow Owner to verify all or a portion of the Claim or to permit Owner access to the books and records of Contractor, or Subcontractors of any tier, shall constitute a waiver of the Claim and shall bar any recovery.
- B. Contractor to make documents available: In support of Owner audit of any Claim, Contractor shall, upon request, promptly make available to Owner the following documents:
1. Daily time sheets and supervisor's daily reports;
 2. Collective bargaining agreements;
 3. Insurance, welfare, and benefits records;
 4. Payroll registers;
 5. Earnings records;
 6. Payroll tax forms;
 7. Material invoices, requisitions, and delivery confirmations;
 8. Material cost distribution worksheet;
 9. Equipment records (list of company equipment, rates, etc.);
 10. Vendors', rental agencies', Subcontractors', and agents' invoices;
 11. Contracts between Contractor and each of its Subcontractors, and all lower-tier Subcontractor contracts and supplier contracts;
 12. Subcontractors' and agents' payment certificates;
 13. Cancelled checks (payroll and vendors);
 14. Job cost report, including monthly totals;
 15. Job payroll ledger;
 16. Planned resource loading schedules and summaries;

17. General ledger;
 18. Cash disbursements journal;
 19. Financial statements for all years reflecting the operations on the Work. In addition, the Owner may require, if it deems it appropriate, additional financial statements for 3 years preceding execution of the Work;
 20. Depreciation records on all company equipment whether these records are maintained by the company involved, its accountant, or others;
 21. If a source other than depreciation records is used to develop costs for Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents;
 22. All nonprivileged documents which relate to each and every Claim together with all documents which support the amount of any adjustment in Contract Sum or Contract Time sought by each Claim;
 23. Work sheets or software used to prepare the Claim establishing the cost components for items of the Claim including but not limited to labor, benefits and insurance, materials, equipment, Subcontractors, all documents which establish the time periods, individuals involved, the hours for the individuals, and the rates for the individuals; and
 24. Work sheets, software, and all other documents used by Contractor to prepare its bid.
- C. Contractor to provide facilities for audit and shall cooperate: The audit may be performed by employees of Owner or a representative of Owner. Contractor, and its Subcontractors, shall provide adequate facilities acceptable to Owner, for the audit during normal business hours. Contractor, and all Subcontractors, shall make a good faith effort to cooperate with Owner's auditors.

PART 9 – TERMINATION OF THE WORK

9.01 TERMINATION BY OWNER FOR CAUSE

- A. 7 Day Notice to Terminate for Cause: Owner may, upon 7 Days written notice to Contractor and to its surety, terminate (without prejudice to any right or remedy of Owner) the Work, or any part of it, for cause upon the occurrence of any one or more of the following events:
1. Contractor fails to prosecute Work: Contractor fails to prosecute the Work or any portion thereof with sufficient diligence to ensure Substantial Completion of the Work within the Contract Time;
 2. Contractor bankrupt: Contractor is adjudged bankrupt, makes a general assignment for the benefit of its creditors, or a receiver is appointed on account of its insolvency;
 3. Contractor fails to correct Work: Contractor fails in a material way to replace or correct Work not in conformance with the Contract Documents;
 4. Contractor fails to supply workers or materials: Contractor repeatedly fails to supply skilled workers or proper materials or equipment;
 5. Contractor failure to pay Subcontractors or labor: Contractor repeatedly fails to make prompt payment due to Subcontractors or for labor;

6. Contractor violates laws: Contractor materially disregards or fails to comply with laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction; or
 7. Contractor in material breach of Contract: Contractor is otherwise in material breach of any provision of the Contract Documents.
- B. Owner's actions upon termination: Upon termination, Owner may at its option:
1. Take possession of Project site: Take possession of the Project site and take possession of or use all materials, equipment, tools, and construction equipment and machinery thereon owned by Contractor to maintain the orderly progress of, and to finish, the Work;
 2. Accept assignment of Subcontracts: Accept assignment of subcontracts pursuant to Section 5.20; and
 3. Finish the Work: Finish the Work by whatever other reasonable method it deems expedient.
- C. Surety's role: Owner's rights and duties upon termination are subject to the prior rights and duties of the surety, if any, obligated under any bond provided in accordance with the Contract Documents.
- D. Contractor's required actions: When Owner terminates the Work in accordance with this section, Contractor shall take the actions set forth in paragraph 9.02B, and shall not be entitled to receive further payment until the Work is accepted.
- E. Contractor to pay for unfinished Work: If the unpaid balance of the Contract Sum exceeds the cost of finishing the Work, including compensation for A/E's services and expenses made necessary thereby and any other extra costs or damages incurred by Owner in completing the Work, or as a result of Contractor's actions, such excess shall be paid to Contractor. If such costs exceed the unpaid balance, Contractor shall pay the difference to Owner. These obligations for payment shall survive termination.
- F. Contractor and Surety still responsible for Work performed: Termination of the Work in accordance with this section shall not relieve Contractor or its surety of any responsibilities for Work performed.
- G. Conversion of "Termination for Cause" to "Termination for Convenience": If Owner terminates Contractor for cause and it is later determined that none of the circumstances set forth in paragraph 9.01A exist, then such termination shall be deemed a termination for convenience pursuant to Section 9.02.

9.02 TERMINATION BY OWNER FOR CONVENIENCE

- A. Owner Notice of Termination for Convenience: Owner may, upon written notice, terminate (without prejudice to any right or remedy of Owner) the Work, or any part of it, for the convenience of Owner.
- B. Contractor response to termination Notice: Unless Owner directs otherwise, after receipt of a written notice of termination for either cause or convenience, Contractor shall promptly:
1. Cease Work: Stop performing Work on the date and as specified in the notice of termination;

2. No further orders or Subcontracts: Place no further orders or subcontracts for materials, equipment, services or facilities, except as may be necessary for completion of such portion of the Work as is not terminated;
 3. Cancel orders and Subcontracts: Cancel all orders and subcontracts, upon terms acceptable to Owner, to the extent that they relate to the performance of Work terminated;
 4. Assign orders and Subcontracts to Owner: Assign to Owner all of the right, title, and interest of Contractor in all orders and subcontracts;
 5. Take action to protect the Work: Take such action as may be necessary or as directed by Owner to preserve and protect the Work, Project site, and any other property related to this Project in the possession of Contractor in which Owner has an interest; and
 6. Continue performance not terminated: Continue performance only to the extent not terminated
- C. Terms of adjustment in Contract Sum if Contract terminated: If Owner terminates the Work or any portion thereof for convenience, Contractor shall be entitled to make a request for an equitable adjustment for its reasonable direct costs incurred prior to the effective date of the termination, plus reasonable allowance for overhead and profit on Work performed prior to termination, plus the reasonable administrative costs of the termination, but shall not be entitled to any other costs or damages, whatsoever, provided however, the total sum payable upon termination shall not exceed the Contract Sum reduced by prior payments. Contractor shall be required to make its request in accordance with the provisions of Part 7.
- D. Owner to determine whether to adjust Contract Time: If Owner terminates the Work or any portion thereof for convenience, the Contract Time shall be adjusted as determined by Owner.

PART 10 – MISCELLANEOUS PROVISIONS

10.01 GOVERNING LAW

Applicable law and venue: The Contract Documents and the rights of the parties herein shall be governed by the laws of the state of Washington. Venue shall be in the county in which Owner's principal place of business is located, unless otherwise specified.

10.02 SUCCESSORS AND ASSIGNS

Bound to successors; Assignment of Contract: Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to the other party hereto and to partners, successors, assigns, and legal representatives of such other party in respect to covenants, agreements, and obligations contained in the Contract Documents. Neither party shall assign the Work without written consent of the other, except that Contractor may assign the Work for security purposes, to a bank or lending institution authorized to do business in the state of Washington. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations set forth in the Contract Documents.

10.03 MEANING OF WORDS

Meaning of words used in Specifications: Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. Reference to standard specifications, manuals, or codes of any technical society, organization, or association, or to the code of any governmental authority,

whether such reference be specific or by implication, shall be to the latest standard specification, manual, or code in effect on the date for submission of bids, except as may be otherwise specifically stated. Wherever in these Drawings and Specifications an article, device, or piece of equipment is referred to in the singular manner, such reference shall apply to as many such articles as are shown on the drawings, or required to complete the installation.

10.04 RIGHTS AND REMEDIES

No waiver of rights: No action or failure to act by Owner or A/E shall constitute a waiver of a right or duty afforded them under the Contract Documents, nor shall action or failure to act constitute approval or an acquiescence in a breach therein, except as may be specifically agreed in writing.

10.05 CONTRACTOR REGISTRATION

Contractor must be registered or licensed: Pursuant to RCW 39.06, Contractor shall be registered or licensed as required by the laws of the State of Washington, including but not limited to RCW 18.27.

10.06 TIME COMPUTATIONS

Computing time: When computing any period of time, the day of the event from which the period of time begins shall not be counted. The last day is counted unless it falls on a weekend or legal holiday, in which event the period runs until the end of the next day that is not a weekend or holiday. When the period of time allowed is less than 7 days, intermediate Saturdays, Sundays, and legal holidays are excluded from the computation.

10.07 RECORDS RETENTION

Six year records retention period: The wage, payroll, and cost records of Contractor, and its Subcontractors, and all records subject to audit in accordance with Section 8.03, shall be retained for a period of not less than 6 years after the date of Final Acceptance.

10.08 THIRD-PARTY AGREEMENTS

No third party relationships created: The Contract Documents shall not be construed to create a contractual relationship of any kind between: A/E and Contractor; Owner and any Subcontractor; or any persons other than Owner and Contractor.

10.09 ANTITRUST ASSIGNMENT

Contractor assigns overcharge amounts to Owner: Owner and Contractor recognize that in actual economic practice, overcharges resulting from antitrust violations are in fact usually borne by the purchaser. Therefore, Contractor hereby assigns to Owner any and all claims for such overcharges as to goods, materials, and equipment purchased in connection with the Work performed in accordance with the Contract Documents, except as to overcharges which result from antitrust violations commencing after the Contract Sum is established and which are not passed on to Owner under a Change Order. Contractor shall put a similar clause in its Subcontracts, and require a similar clause in its sub-Subcontracts, such that all claims for such overcharges on the Work are passed to Owner by Contractor.

10.10 HEADINGS AND CAPTIONS

Headings for convenience only: All headings and captions used in these General Conditions are only for convenience of reference, and shall not be used in any way in connection with the meaning, effect, interpretation, construction, or enforcement of the General Conditions, and do not define the limit or describe the scope or intent of any provision of these General Conditions.

See Supplemental Conditions 10.11, 10.12, and 10.13 which add new General Conditions Parts 10.11.10.12. and 10.13.

**SUPPLEMENTAL CONDITIONS
FOR WASHINGTON STATE FACILITIES CONSTRUCTION**
(Paragraphs keyed to the State's General Conditions)

2.02 Replaces Section 2.02 – INSURANCE COVERAGE LIMITS and CERTIFICATES

A. Insurance Coverage Certificates and Policies

The Contractor shall furnish acceptable proof of insurance coverage on the state of Washington Certificate of Insurance form SF500A, dated 07/02/92 or ACORD form, as well as copies of insurance policies.

B. Required Insurance Coverages

1. For a contract less than \$100,000.00, the coverage required is:

- a. Comprehensive General Liability Insurance – The Contractor shall at all times during the term of this contract, at its cost and expense, carry and maintain general public liability insurance, including contractual liability, against claims for bodily injury, personal injury, death or property damage occurring or arising out of services provided under this contract. This insurance shall cover claims caused by any act, omission, or negligence of the Contractor or its officers, agents, representatives, assigns or servants. The limits of liability insurance, which may be increased as deemed necessary by the contracting parties, shall be:

Each Occurrence	\$1,000,000.00
General Aggregate Limits (other than products – commercial operations)	\$1,000,000.00
Products – Commercial Operations Limit	\$1,000,000.00
Personal and Advertising Injury Limit	\$1,000,000.00
Fire Damage Limit (any one fire)	\$50,000.00
Medical Expense Limit (any one person)	\$5,000.00

- b. If the contract is for underground utility work, then the Contractor shall provide proof of insurance for that above in the form of Explosion, Collapse and Underground (XCU) coverage.

- c. Employers Liability on an occurrence basis in an amount not less than \$1,000,000.00 per occurrence.

2. For contracts over \$100,000.00 but less than \$5,000,000.00 the contractor shall obtain the coverage limits as listed for contracts below \$100,000.00 and General Aggregate and Products – Commercial Operations Limit of not less than \$2,000,000.00.

3. Coverage for Comprehensive General Bodily Injury Liability Insurance for a contract over \$5,000,000.00 is:

Each Occurrence	\$2,000,000.00
General Aggregate Limits (other than products – commercial operations)	\$4,000,000.00
Products – Commercial Operations limit	\$4,000,000.00
Personal and Advertising Injury Limit	\$2,000,000.00

Fire Damage Limit (any one fire)	\$50,000.00
Medical Expense Limit (any one Person)	\$5,000.00

4. For all Contracts – Automobile Liability: in the event that services delivered pursuant to this contract involve the use of vehicles or the transportation of clients, automobile liability insurance shall be required. If Contractor-owned personal vehicles are used, a Business Automobile Policy covering at a minimum Code 2 “owned autos only” must be secured. If Contractor employee’s vehicles are used, the Contractor must also include under the Business Automobile Policy Code 9, coverage for non-owned autos. The minimum limits for automobile liability is: \$1,000,000.00 per occurrence, using a combined single limit for bodily injury and property damage.
5. For Contracts for Hazardous Substance Removal (Asbestos Abatement, PCB Abatement, etc.)
 - a. In addition to providing insurance coverage for the project as outlined above, the Contractor shall provide Pollution Liability insurance for the hazardous substance removal as follows:

<u>EACH OCCURRENCE</u>	<u>AGGREGATE</u>
\$500,000.00	\$1,000,000.00

or \$1,000,000.00 each occurrence/aggregate bodily injury and property damage combined single limit.

- 1) Insurance certificate must state that the insurer is covering hazardous substance removal.
- 2) Should this insurance be secured on a “claims made” basis, the coverage must be continuously maintained for one year following the project’s “final completion” through official completion of the project, plus one year following.

For Contracts where hazardous substance removal is a subcomponent of contracted work, the general contractor shall provide to the Owner a certificate of insurance for coverage as defined in 5a. above. The State of Washington must be listed as an additional insured. This certificate of insurance must be provided to the Owner prior to commencing work.

2.04 Replaces Section 2.04 - PAYMENT AND PERFORMANCE BONDS

Conditions for bonds: Payment and performance bonds for 100% of the Contract Award Amount, plus state sales tax, shall be furnished for the Work, using the Payment Bond and Performance Bond form published by and available from the American Institute of Architects (AIA) – form A312. Prior to execution of a Change Order that, cumulatively with previous Change Orders, increases the Contract Award Amount by 15% or more, the Contractor shall provide either new payment and performance bonds for the revised Contract Sum, or riders to the existing payment and performance bonds increasing the amount of the bonds. The Contractor shall likewise provide additional bonds or riders when subsequent Change Orders increase the Contract Sum by 15% or more.

No payment or performance bond is required if the Contract Sum is \$150,000 or less and the Contractor or General Contractor/Construction Manager agrees that Owner may, in lieu of the bond, retain 10% of the Contract Sum for the period allowed by RCW 39.08.010.

3.02 Replaces Section 3.02 B – CONSTRUCTION SCHEDULE

B. Form of Progress Schedule: The Progress Schedule shall be in the form of a Critical Path Method (CPM) logic network or, with the approval of the Owner, a bar chart schedule may be submitted. The scheduling of construction is the responsibility of the Contractor and is included in the contract to assure adequate planning and execution of the work. The schedule will be used to evaluate progress of the work for payment based on the Schedule of Values. The schedule shall show the Contractor's planned order and interdependence of activities, and sequence of work. As a minimum the schedule shall include:

1. Date of Notice to Proceed;
2. Activities (resources, durations, individual responsible for activity, early starts, late starts, early finishes, late finishes, etc.);
3. Utility Shutdowns;
4. Interrelationships and dependence of activities;
5. Planned vs. actual status for each activity;
6. Substantial completion;
7. Punch list;
8. Final inspection;
9. Final completion, and
10. Float time

The Schedule Duration shall be based on the Contract Time of Completion listed on the Bid Form. The Owner shall not be obligated to accept any Early Completion Schedule suggested by the Contractor. The Contract Time for Completion shall establish the Schedule Completion Date.

If the Contractor feels that the work can be completed in less than the Specified Contract Time, then the Surplus Time shall be considered Project Float. This Float time shall be shown on the Project Schedule. It shall be available to accommodate changes in the work and unforeseen conditions.

Neither the Contractor nor the Owner have exclusive right to this Float Time. It belongs to the project.

5.01 Replaces Section 5.01 B & D - CONTRACTOR CONTROL AND SUPERVISION

B. Competent Superintendent required: Performance of the Work shall be directly supervised by a competent superintendent who has authority to act for Contractor. The superintendent must be satisfactory to the Owner and shall not be changed without the prior written consent of Owner. Owner may require Contractor to remove the superintendent from the Work or Project site, at no cost to the Owner for delay or any other claim, if Owner reasonably deems the superintendent incompetent, negligent, or otherwise objectionable, provided Owner has first notified Contractor in writing and allowed a reasonable period for transition. Noncompliance with the Owner's request to remove and replace the superintendent for a material reason shall also be grounds for terminating the Contract for cause.

D. Contractor to employ competent and disciplined workforce: Contractor shall enforce strict discipline and good order among all of the Contractor's employees and other persons performing the Work. Contractor shall not permit employment of persons not skilled in tasks assigned to them. Contractor's employees shall at all times conduct business in a manner which assures fair, equal, and nondiscriminatory treatment of all persons. Owner may, by written notice, require Contractor to remove from the Work or Project site, at no cost to the Owner for delay or any other claim, any employee Owner reasonably deems incompetent,

negligent, or otherwise objectionable. Noncompliance with the Owner's request to remove and replace personnel at any level for a material reason shall also be grounds for terminating the Contract for cause.

5.02 Replaces Section 5.02 B – PERMITS, FEES AND NOTICES

- B. Allowances for permit fees: The actual cost of the general building permit (only) and the public utility hook-up fees will be a direct reimbursement to the Contractor or paid ***directly to the permitting agency by the Owner. Fees for these permits should not be included by the Contractor in his bid amount***

Add New Section 5.02 D – PERMITS, FEES, AND NOTICES

- D. Contractor to submit copies: The General Contractor shall submit copies of each valid permit required on the project to the Owner's representative. Nothing in this part shall be construed as imposing a duty upon the Owner or A/E to secure permits.

5.04 Replaces 5.04, Section A – PREVAILING WAGES

- A. Contractor to pay Prevailing Wages or applicable Federal Wages: Contractor shall pay the prevailing rate of wages to all workers, laborers, or mechanics employed in the performance of any part of the Work in accordance with RCW 39.12 and the rules and regulations of the Department of Labor and Industries. The schedule of prevailing wage rates for the locality or localities of the Work, is determined by the Industrial Statistician of the Department of Labor and Industries. It is the Contractor's responsibility to verify the applicable prevailing wage rate. If applicable, the Contractor shall comply with all Federal Funding requirements of the Davis Bacon Act that will be addressed in a separate "DIVISION 00 SPECIAL CONDITIONS" specification section that will be based on the specific requirements of the funding source. .

5.04 Replaces 5.04, Section G – Certified Payrolls

- G. Certified Payrolls: Consistent with WAC 296-127-320, the Contractor and any subcontractor shall submit a certified copy of payroll records if requested. If applicable, the Contractor shall comply with all Federal Funding requirements of the Davis Bacon Act that will be addressed in a separate "DIVISION 00 SPECIAL CONDITIONS" specification section that will be based on the specific requirements of the funding source.

5.06 Replaces 5.06, Section A – NONDISCRIMINATION

- A. Discrimination prohibited by applicable laws: The Contractor and all Subcontractors shall comply with all applicable federal and state non-discrimination laws, regulations, and policies. No person shall, on the grounds of age, race, creed, color, sex, sexual orientation, religion, national origin, marital status, honorably discharged veteran or military status, or disability (physical, mental, or sensory) be denied the benefits of, or otherwise be subjected to discrimination under any project, program, or activity, funded, in whole or in part, under this Agreement.

5.07 Replaces 5.07, Section A – SAFETY PRECAUTIONS

- A. In performing this contract, the Contractor shall provide for protecting the lives and health of employees and other persons; preventing damage to property, materials, supplies, and equipment; and avoid work interruptions. For these purposes, the Contractor shall:
1. Follow Washington Industrial Safety and Health Act (WISHA) regional directives and provide a site-specific safety program that will require an accident prevention and hazard analysis plan for the contractor and each subcontractor on the work site. The Contractor shall submit a site-specific safety plan to the Owner's representative prior to the initial scheduled construction meeting.
 2. Provide adequate safety devices and measures including, but not limited to, the appropriate safety literature, notice, training, permits, placement and use of barricades, signs, signal lights, ladders, scaffolding, staging, runways, hoist, construction elevators, shoring, temporary lighting, grounded outlets, wiring, hazardous materials, vehicles, construction processes, and equipment required by all applicable state, federal, and local laws and regulations.
 3. Comply with the State Environmental Policy Act (SEPA), Clean Air Act, Shoreline Management Act, and other applicable federal, state, and local statutes and regulations dealing with the prevention of environmental pollution and the preservation of public natural resources.
 4. Post all permits, notices, and/or approvals in a conspicuous location at the construction site.
 5. Provide any additional measures that the Owner determines to be reasonable and necessary for ensuring a safe environment in areas open to the public. Nothing in this part shall be construed as imposing a duty upon the Owner or A/E to prescribe safety conditions relating to employees, public, or agents of the Contractors.

5.20 Add New Paragraph A. 6. – SUBCONTRACTORS AND SUPPLIERS

6. Within the three-year period immediately preceding the date of the bid solicitation, not have been determined by a final and binding citation and notice of assessment issued by the department of labor and industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in RCW 49.48.082, any provision of chapter 49.46, 49.48, or 49.52 RCW.

5.20 Replace Paragraph B – SUBCONTRACTORS AND SUPPLIERS

- B. Use qualified Subcontractors: Contractor shall utilize Subcontractors and suppliers, which are experienced and qualified, and meet the requirements of the Contract Documents, if any. Contractor shall not utilize any Subcontractor or supplier to whom the Owner has a reasonable objection, and shall obtain Owner's written consent before making any substitutions or additions.

7.02 Replace Paragraph B.7.c – CHANGE IN THE CONTRACT SUM, Change Order Pricing – Fixed Price, Components of Increased Cost

- c. Equipment costs: This is an itemization of the type of equipment and the estimated or actual length of time the construction equipment appropriate for the Work is or will be

used on the change in the Work. Costs will be allowed for construction equipment only if used solely for the changed Work, or for additional rental costs actually incurred by the Contractor. Equipment charges shall be computed on the basis of actual invoice costs or if owned, from the current edition of one of the following sources:

- (1) The National Electrical Contractors Association for equipment used on electrical work.
- (2) The Mechanical Contractors Association of America for equipment used on mechanical work.
- (3) The EquipmentWatch Fleet Manager Estimator Package (digital). The maximum rate for standby equipment shall not exceed that shown in the Associated General Contractors Washington State Department of Transportation (AGC WSDOT) Equipment Rental Agreement, current edition on the Contract execution date.

10.11 Add Part 10.11 – DIVERSE BUSINESS PARTICIPATION

The state of Washington encourages participation in all of its contracts by Diverse Businesses as found in RCW Chapters 39, 43, and WAC 326. The voluntary Diverse Business goal of 26%, which is an aggregate of: 10% Minority Business Enterprises (MBE), 6% Women Business Enterprises (WBE), 5% Veteran-owned Business, and 5% Washington Small Businesses self-identified in the Washington Electronic Business Solution (WEBS) <http://www.des.wa.gov/services/ContractingPurchasing/Business/Pages/WEBSRegistration.aspx>. Contractors are encouraged to meet or exceed the project goals in the advertisement by any level of participation, regardless of category.

DES reserves the right to adjust the voluntary participation goals.

Businesses are encouraged to register in WEBS, as well as registering as a state certified M/WBE/Veteran Business.

For reporting, Contractor is required to register and create an account in the DES Diversity Compliance Program (B2GNow) at <https://des.diversitycompliance.com/>.

Every month for the duration of your contract, and while your contract is active in the B2Gnow system, submit and accurately maintain the following information through B2Gnow:

- a. Payments received by the prime contractor from the Agency
- b. Payments paid to each first tier subcontractor
- c. Payments paid to each first tier supplier

You must also ensure the following information is reported in the B2Gnow system by your first tier subcontractors and suppliers for the duration of your contract:

- a. Confirmation of payments from the prime contractor to the first tier subcontractor
- b. Confirmation of payments from the prime contractor to first tier suppliers

10.12 Add Part 10.12 - MINIMUM LEVELS OF APPRENTICESHIP PARTICIPATION

In accordance with RCW 39.04.320, the State of Washington requires 15% apprenticeship participation for projects estimated to cost one million dollars or more.

- A. Apprentice participation, under this contract, may be counted towards the required percentage (%) only if the apprentices are from an apprenticeship program registered and approved by the Washington State Apprenticeship and Training Council (RCW 49.04 and WAC 296-05).

- B. Bidders may contact the Department of Labor and Industries, Specialty Compliance Services Division, Apprenticeship Section, P.O. Box 44530, Olympia, WA 98504-4530 by phone at (360) 902-5320, and e-mail at Apprentice@Lni.wa.gov, to obtain information on available apprenticeship programs.
- C. For each project that has apprentice requirements, the contractor shall submit a “**Statement of Apprentice and Journeyman Participation**” on forms provided by the Department of Enterprise Services, with every request for progress payment. The Contractor shall submit consolidated and cumulative data collected by the Contractor and collected from all subcontractors by the Contractor. The data to be collected and submitted includes the following:
 - 11. Contractor name and address
 - 12. Contract number
 - 13. Project name
 - 14. Contract value
 - 15. Reporting period “Beginning Date” through “End Date”
 - 16. Name and registration number of each apprentice by contractor
 - 17. Total number of apprentices and labor hours worked by them, categorized by trade or craft
 - 18. Total number of journeymen and labor hours worked by them, categorized by trade or craft
 - 19. Cumulative combined total of apprentice and journeymen labor hours
 - 20. Total percentage of apprentice hours worked
- D. No changes to the required percentage (%) of apprentice participation shall be allowed without written approval of the Owner. In any request for the change, the Contractor shall clearly demonstrate a good faith effort to comply with the requirements for apprentice participation.
- E. Any substantive violation of the mandatory requirements of this part of the contract may be a material breach of the contract by the Contractor. The Owner may withhold payment pursuant to Part 6.05, stop the work for cause pursuant to Part 3.04, and terminate the contract for cause pursuant to Part 9.01.

10.13 Add Part 10.13 – SPECIAL CONDITIONS

The Owner may have Federal Funding or other special requirements for this project. If applicable, the Contractor will be required to comply with the “DIVISION 00 SPECIAL CONDITIONS” section in the specifications that will be based on the specific requirements of the funding source.



CERTIFICATE OF
INSURANCE

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY.
THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE
COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURED (Legal name and business address)	CERTIFICATE HOLDER: STATE OF WASHINGTON	<u>CONTRACT NUMBER</u>
	DEPT. OF ENTERPRISE SERVICES	<u>DATE ISSUED:</u>
	DIVISION OF E&A SERVICES	
	1500 JEFFERSON STREET SE	
	OLYMPIA, WASHINGTON 98501	

PROJECT DESCRIPTION / LOCATIONS / VEHICLES / RESTRICTIONS / SPECIAL ITEMS:

This is to certify that policies of Insurance listed below have been issued to the Insured named above for the policy period indicated.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	Date Policy Effective (MM/DD/YY)	Date Policy Expires (MM/DD/YY)	ALL LIMITS IN THOUSANDS	
	GENERAL LIABILITY <input type="checkbox"/> Commercial General Liability <input type="checkbox"/> Claims Made <input type="checkbox"/> Occurrence <input type="checkbox"/> Owner's & Contractors Protection Deductible \$ _____				General Aggregate \$ _____ Products Comp/Ops Aggregate \$ _____ Personal & Advertising Injury \$ _____ Each Occurrence \$ _____ Fire Damage (Any One Fire) \$ _____ Medical Expense (Any One Person) \$ _____	
	AUTOMOBILE LIABILITY <input type="checkbox"/> Any Auto <input type="checkbox"/> All Owned Autos <input type="checkbox"/> Scheduled Autos <input type="checkbox"/> Hired Autos <input type="checkbox"/> Non-Owned Autos <input type="checkbox"/> Garage Liability Deductible \$ _____				CSL \$ _____ Bodily Injury (per person) \$ _____ Bodily Injury (per accident) \$ _____ Property Damage \$ _____	
	EXCESS LIABILITY <input type="checkbox"/> Other Than Umbrella Form				Each Occurrence \$ _____ Aggregate \$ _____	
	WORKERS COMPENSATION AND EMPLOYER'S LIABILITY				STATUTORY \$ _____ (Each Accident) \$ _____ (Disease Policy Limit) \$ _____ (Disease-Each Employee)	
	OTHER					

ADDITIONAL PROVISIONS

The State of Washington is included as additional insured as related to the above mentioned project.
Should any of the above described policies be cancelled before the expiration date thereof, the issuing Company must deliver or mail not less than a 45 days written notice to the above Certificate Holder, per RCW 48.18.290

COMPANIES AFFORDING COVERAGE		ISSUING COMPANY, AGENT OR REPRESENTATIVE	
NOTE: Attach a separate sheet to this certificate giving all the company names and their percentage of coverage, if clarification is needed,		NAME:	
		ADDRESS:	
Company Letter	A	Authorized Signature	
	B		Title
	C		Signature Date
	D		Signee Name
	E		Telephone No.

Liquidated Damage Checklist

Date: _____

Project No. _____

Project Title: _____

E&AS PM: _____

A/E PM: _____

The following is the basis for calculating a reasonable approximation of the daily cost damages to the Owner, should the completion of this construction project exceed the Substantial Completion date. The Contract Completion date is the date written into the contract and/or as adjusted by Change Order.

The damages may change depending upon the variables associated with time. Therefore, some contracts may require more than one liquidated damage amount to calculate a fair estimated cost. In Section I, indicate each condition of probable damage due to time. In Section II, calculate the unit cost for each item listed in Section I, add additional Section II sheets as necessary.

For information on actual damages, see the General Conditions, paragraph 3.07.

SECTION I - Probable Conditions at Time of Damage

The estimated liquidated damages for this project were calculated based on the following assumptions:

- A) The Owner will not have occupancy and usage of the project as specified.
- B) The Owner will have occupancy and usage of the project as intended, but the project is not substantially complete.
- C) Interim milestones:
 - 1) _____
 - 2) _____
 - 3) _____

SECTION II - Damage calculation for Section I

These estimated damages are based on the time from the scheduled Substantial Completion Date to the actual Substantial Completion Date. All information supporting these estimates should be attached.

	<u>Daily Cost</u>	<u>Notes</u>
1) Temporary Facilities	_____	_____
2) Leasing Costs	_____	_____
3) Rental Costs	_____	_____
4) Utilities	_____	_____
5) A/E Consultant Fees	_____	_____
6) Site Representative Fees	_____	_____
7) Agency Project Management	_____	_____
8) Additional staff or temporary employees, i.e. guards, nurses, etc.	_____	_____
9) Additional Facility costs	_____	_____
10) Other costs:	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
LIQUIDATED DAMAGE TOTAL:	_____	_____

Notes (Required if liquidated damages in bid documents differs from checklist):

PART 1 - GENERAL

1.1 DESCRIPTIONS AND DEFINITIONS

- A. The State of Washington prevailing wage rates are applicable for this public works project located in Spokane County. Bidders are responsible to verify and use the most recent prevailing wage rates. The "Effective Date" for this project is the Bid Proposal due date. The applicable prevailing wage rates may be found on the Department of Labor and Industries website located at <https://fortress.wa.gov/lni/wagelookup/prvWagelookup.aspx>.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 00 73 13

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.01 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.

1.02 WORK COVERED BY THE CONTRACT DOCUMENTS

- A. This project includes various trades. Coordinating of construction activities by the Contractor will be required to ensure that the project will not affect the operation of College personnel throughout the entire construction process. Site access is limited and adjacent areas will remain occupied during construction.

- 1. Each trade is governed by General and Supplemental Conditions of the Contract and all provisions of Division 1, General Requirements, whether or not specifically referenced for its particular work.

- B. Briefly, and without force and effect upon the Contract Documents, the Work of the Contract can be summarized as follows:

Work consists of remodeling existing offices and storage areas to create new offices and lounges. HVAC, five sprinklers and electrical systems shall be reconfigured to serve the plan changes. Work shall be performed in two phases.

- D. The Work is included in a single Base Bid, plus alternate bids, if indicated and as accepted.

1.03 SPECIAL REQUIREMENTS

- A. Special requirements and conditions apply to the work of this contract and are intended to limit the disruption of existing operations. Refer to Section TEMPORARY FACILITIES & CONTROLS, Section 01 50 00.

- B. The Contractor shall photograph and videotape in sufficient detail the existing interior and/or exterior and grounds of all areas that will be affected by construction and haul routes to substantiate existing conditions that might otherwise be construed as damage caused by the Contractor. Date all material and deliver a copy to the Owner within (7) days following the Notice to Proceed. Any damage within the limits of construction or areas used by the Contractor outside of the limits of construction shall be the responsibility of the Contractor to repair unless the damage can be positively identified by photograph or videotape as being a previously existing condition.

1.04 HAZARDOUS MATERIALS

- A. No hazardous materials have been identified or are known to exist within the project area at the time of bid. Should any work activities by this Contract discover/disturb any additional hazardous material, the Contractor is directed to immediately cease work activity in the area found to be potentially hazardous, notify the Owner, and await Owner's directions as the appropriate action to be initiated.
- B. All products used in the construction shall be asbestos free. Products which are described as "less than 1% asbestos" or "virtually asbestos free" are not acceptable. Only products which are asbestos free are permitted in the construction of this project.
- C. All paint products used in the construction shall be lead free.

1.05 WORK UNDER OTHER CONTRACTS

- A. Work on the Project which may be executed by others and which is excluded from this Contract, are as follows:
 - 1. Prior to the Contractor's Notice to Proceed, the Owner will remove all moveable items within the limits of construction that are not identified to remain or be removed or reused by the contractor.
 - 2. The removal from the construction area of any containers of toxic or hazardous chemicals or materials is to be accomplished by the Owner prior to any construction activities commencing. Should there be any known hazardous materials left in the construction area, Contractor shall be informed by the Owner pursuant to Article 5.07 of the General Conditions.

1.06 WORKING HOURS

- A. The project site will be occupied during the course of this project. At any given time, agencies and tenants may or do operate twenty-four (24) hours per day, seven (7) days per week.
- B. Contractor's normal working hours for this project shall be defined as follows:

Normal working hours for this project are defined as 7:00am to 6:00pm Monday through Friday.

Contractor's normal working hours may, at Contractor's option, also include weekends as coordinated with CCS Project Coordinator.

Owner approval of weekend work must be obtained before weekend work will be permitted. Contractor shall notify Owner of intent to engage in weekend work a minimum of seven (7) days in advance of dates of work. Owner reserves right to deny request for weekend work depending on potential conflicts with other activities that may be occurring. Denial of request for weekend work shall not be cause for a delay claim to project.

- C. All service outages and electrical tie-ins will be required to be made at specific times and may occur only with advance notification and Owner approval. The Contractor shall be responsible for scheduling and completing this work in compliance with the requirements of the contract documents. Refer to Temporary Facilities & Controls for scheduling service interruptions and outages with the Owner. Refer to Project Coordination for specified utility outage and tie-in requirements.
- D. At the end of the Contractor's normal working hours, adjacent areas to the Project shall be suitable for normal operations. The Contractor shall continue working, at no additional cost, to rectify anything affecting normal tenant operations caused by Contractor work.

- E. The Contractor shall provide the Owner a contact list of people who are capable of addressing an emergency issue that may occur outside of Contractor's normal working hours. See 01 31 15.

1.07 PREMIUM PAY

- A. Any overtime required to complete this Project outside the Contractor's defined normal working hours shall be included as a part of this contract. No additional payments will be authorized for work performed on weekends, holidays, time required to attend meetings outside the Contractor's normal working hours, or time outside the Contractor's normal working hours required to communicate any identified issues from a previous work shift.

1.08 OWNER'S USE OF PREMISES

- A. Owner will vacate the area of the building where work is to occur and make the work area accessible to the Contractor by the date of the Notice to Proceed.
- B. There will be other spaces in use by the College in the vicinity of this project. The Contractor shall coordinate construction staging and access to the Work to avoid disruption to activities within the building and Campus.
- C. Owner's personnel will be present on a limited basis during the construction period as necessary to maintain or inspect existing facilities.
 - 1. Contractor shall provide Owner's personnel reasonable and safe access and escort as needed to maintain and inspect facilities.

1.10 CONTRACTOR USE OF THE PREMISES

- A. During the construction period the Contractor shall have use of the premises in areas containing project work as indicated in the Contract Documents. Coordinate ingress and egress to minimize disruption of traffic and Owner's use of the premises. Contractors shall not block ingress and egress to accessible entrance, accessible routes of travel or accessible parking.
- B. Contractor shall control, secure and have responsibility for the work area from the date when the area is vacated by Owner to the date of Substantial Completion. This area shall generally include:
 - Area within limits of construction as shown on the drawings.
- C. All Contractor's personnel and subcontractor's shall have I.D. tags issued by Owner.
- D. Monitor and secure portions of the buildings under Contractor's control to prevent unauthorized access. Inspect premises at end of each work day to ensure all doors are locked and exterior openings are closed and secure.
 - Exterior doors of building shall remain locked at all times after regular building hours.
- E. Keep existing driveways and entrances serving the premises clear at all times. Do not use these areas for parking or storage of materials, except where noted.
- F. Do not unreasonably encumber the sites with materials or equipment. No stockpiling of materials shall be allowed outside the limits of construction. If short term storage is necessary on-site, the Owner will designate a location upon request.

- G. Limit construction access to only those areas that require work under this Contract.
- H. Contractor is fully responsible for damage or loss that occurs to existing facilities, occupants and public as a result of the work performed. Take precautions to protect existing facilities, occupants and public. Immediately repair or replace items damaged or lost as a result of work under the Contract.
- I. Cooperate fully with the Owner during construction operations to minimize disruptions of Owner's operations at and around the project site.
- J. Assume full responsibility for protection and safekeeping of products stored on-site.
- K. Do not use the following area except as indicated:
 - 1. Owner occupied areas and accessible route of travel without permission
 - 2. Parking or accessible parking areas other than indicated.
 - 3. Owner's garbage and recycle dumpsters.
- L. Maintain water and electrical service to building during construction period.
- M. The existing building and surrounding surfaces that are affected by this Project are to be maintained in a watertight condition throughout the construction period. At all times during the Project, the Contractor is to cover any existing horizontal or vertical surfaces exposed by construction work which have not been made watertight by the installation of new materials prior to the end of the work shift. Repair damage immediately caused by water infiltration.
- N. Schedule deliveries after 2:00pm. All deliveries must be supervised by Contractor. Traffic and pedestrian control shall be provided by Contractor during deliveries.

1.11 MISCELLANEOUS PROVISIONS

- A. Notify subcontractors to become familiar with requirements of Division 00, Division 01 and the work of Sections related to their own work. Instruct them that these conditions and requirements apply to their work in each Section of the technical specifications.
- B. Contractors and Subcontractors submitting bids for this Project are required to thoroughly familiarize themselves with specified products and installation procedures. Submit any objections or substitution requests for the products and procedures specified in accordance with Product Requirements. Submittal of Bid constitutes acceptance of products and procedures specified.
- C. Conflicts & Omissions in Contract Documents
 - 1. Bring immediately to A/E's attention any conflicts and omissions between the Drawings and Specifications and between the Drawings or Specifications and actual site conditions. In the event of a conflict or discrepancy among or in the Contract Documents, interpretation shall be governed as indicated in Article 1.02 of the General Conditions For Washington State Facility Construction.
 - 2. Where conflicts and omissions have not been brought to A/E's attention, it is understood that Contractor has figured the most costly method or methods.
- D. It is the Contractor's responsibility to verify all field measurements, survey control, staking and conditions. No allowance will be made for any items incorrectly fabricated or installed due to failure to perform such verification prior to commencing the work.

1.16 PERMITS AND FEES

A. General

1. The Owner will pay for the Building Permit.
 2. The Contractor shall obtain all other permits and local business licenses necessary for the execution of the work and pay all permit (except as indicated in paragraph "1" above), utility and miscellaneous fees required by the appropriate Authority Having Jurisdiction (AHJ).
 3. The Contractor shall coordinate and schedule all work with respective permitting agencies and utility companies necessary for completion of the work.
 4. Contractor shall be responsible for providing all information, documents, and fees to the permitting agencies and utility companies within 30 days after issuance of the Notice to Proceed as necessary to obtain and coordinate permits and utility connections.
- B. The Drawings and Specifications have been submitted for plan review to the appropriate AHJ, so that permits will be available to the Contractor for this project on or before the Date of Notice to Proceed.

1.17 PHASING OF THE WORK

- A. Work shall be conducted in two phases. After Phase-1 work is Substantially Complete, the Owner will vacate the Phase-2 area and occupy the Phase-1 area. The Owner will require four calendar days to make the move once the Phase-1 area is determined to be Substantially Complete by the Architect.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

The Contractor shall be aware of all special requirements for the Project execution described in the Contract Documents. These items consist of, but are not limited to: specific time frames for work, sequence and special requirements for demolition, load limits, and all other criteria described in the Contract Documents.

END OF SECTION 01 11 00

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SECTION 01 23 00

ALTERNATES

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 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 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 alternate 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. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates 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

SCHEDULE OF ALTERNATES

- A. Alternate No. 01: (3) Private Offices in Student Leadership Space
 - 1. Base Bid: Relocated cubicles (OFOI) in lieu of private offices at Leadership 102D
 - 2. Alternate No 01: Add following rooms: Alt-1 Office 130, Alt-1 Office 131 and Alt-1 Office 132 to Student Leadership 102D as indicated in drawings. See A-400, Mechanical drawings and electrical drawings for extent of alternate.

- B. Alternate No. 02: Wood Ceiling
 - 1. Base Bid: Gypsum Board Ceiling with Film-2 finish at underside, suspended with return walls at Lounge 115
 - 2. Alternate No. 02: Suspended Wood Grille Ceiling System (WLC-1 in Finish Legend)

- C. Alternate No. 03: Roller Shades
 - 1. Base Bid: Maintain existing window coverings at exterior window within Scope of Work. Alternate No. 03: Remove and salvage to owner window shades at all exterior windows within Scope of Work. Provide new jamb mount roller shades (RS-2) in Finish Legend at all exterior windows within Scope of Work at full width and height of windows. Patch ceiling wall where existing shade removed and repaint.

- D. Alternate No. 04: New Rooftop Unit – MZU-5
 - 1. Base Bid: New packaged rooftop unit, RTU-1 with gas fired furnace and DX cooling. The unit will serve the new student government open office area.
 - 2. Alternate No. 04: Replace the existing MZU-5 which is the primary AHU serving the SW portion of the SCC Lair building. The new unit will have DX cooling and hydronic heating. The heating system will tie into the existing boiler system.

END OF SECTION 01 23 00

SUBSTITUTION REQUEST FORM



TO _____

PROJECT _____

1. We hereby submit for your consideration the following product instead of the specified item for the above project:

<u>Section</u>	<u>Page</u>	<u>Line/Paragraph</u>	<u>Specified Item</u>
_____	_____	_____	_____

2. Proposed Substitution: _____

3. Reason for Substitution: _____

4. Attach complete technical data, including laboratory tests, if applicable.

5. Include complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

6. Does the substitute affect dimensions shown on Drawings? _____

6a. If so, how? _____

7. Will the undersigned pay for changes to the building and systems design, including engineering and detailing costs caused by the requested substitution? _____

8. Describe the effect substitution has on other trades: _____

9. Differences between proposed substitution and specified item: _____

10. Manufacturer's guarantees of proposed and specified items are: Same Different (explain on attachment)

The undersigned states that the function, appearance and quality are equivalent or superior to the specified item.

SUBMITTED BY:

Signature

Firm

Mailing Address

City State Zip

Telephone

Date

Please check if there are attachments.

FOR USE BY REVIEWER:

Accepted Accepted as Noted

Not Accepted Received Too Late

Approved for Bidding subject to review and approval of Submittals.

By _____

Date _____

Remarks _____

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

- A. Requirements for Changes are also included in Part 7 of the General Conditions For Washington State Facility Construction and Supplemental Conditions. This Section specifies additional detail regarding administrative and procedural requirements for handling and processing contract modifications. In the event of conflicts between this specification and Part 7, the General Conditions and Supplemental Conditions shall supercede any requirements identified herein.

1.03 MINOR CHANGES IN THE WORK

- A. The A/E will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on a form prepared by the A/E. If the contractor believes a cost is associated with the supplemental instructions, the Contractor is to provide written notice to the A/E within 7 days of receipt of the instructions.

1.04 OTHER CHANGES IN THE WORK

- A. Changes to the work can be by:
 - 1. Change Order Proposal issued by the A/E to the Contractor on the Owner's behalf.
 - 2. Field Authorization issued by the A/E to the Contractor on the Owner's behalf.
 - 3. Request initiated by the Contractor and submitted to the A/E.
- B. Change Order Proposal (COP). The A/E will issue a detailed description of proposed Owner initiated changes in the Work on the Owner's standard COP form that may require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. COP requests issued by the A/E are for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.
 - 2. Within 14 calendar days of receipt of a proposal request, or quicker if the projectschedule necessitates, the contractor shall submit an estimate of cost necessary to execute the change to the A/E who will evaluate the cost and make a recommendation for the Owner's review.
- C. Field Authorization (FA). The A/E may issue, on behalf of the Owner, a FA instructing the Contractor to proceed with a change or specific portion of the change in the Work or specific portion of a COP, for subsequent inclusion in a Change Order.
 - 1. The FA will contain a complete description of the change in the Work. It also designates the method to be followed to determine change in the Contract Sum or Contract Time.

2. The Contractor must provide a Not To Exceed (NTE) amount to be indicated on the FA.
 3. As the Work progresses, the Contractor is to monitor its costs. If the costs indicate they will exceed the NTE prior to being able to complete the work, the Contractor is to stop work and notify the Owner. A decision will be made by the Owner to stop the change at that time, or authorize an increase in the NTE amount.
 4. The Contractor is not to proceed with the work until the FA is signed by the Contractor, A/E, Owner, and E&AS Project Manager.
 5. Maintain detailed records of time and material documentation of work as required by the Field Authorization.
 - a. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
 - b. Include daily accounting of time spent by each person working specifically on such work, signed by Owner's Site Representative, together with copies of all related purchase orders.
- D. Contractor Initiated Change Request. When latent, unforeseen, or other conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the A/E.
1. Provide initial documentation describing the proposed change, reason for changes, and why the proposed change is not part of the Base Bid.
- E. Detailed Documentation of Owner or Contractor initiated Changes.
1. Support each lump sum proposal quotation, and each unit price (not previously established) with sufficient substantiating data.
 2. On request, provide additional data to support time and cost computations:
 - a. Labor required.
 - b. Equipment required.
 - c. Products required.
 - 1) Recommended source of purchase and unit cost.
 - 2) Quantities required.
 - d. Taxes, insurance, and bonds.
 - e. Documented credit for work deleted from Contract.
 - f. Overhead and profit.
 - g. Justification for any change in Contract Time.
 3. Support each proposal for additional costs, and time-and-material/force account work with documentation, as required for lump-sum proposal. Include additional information:
 - a. Name of A/E or Owner's authorized agent who ordered work, and date of order.
 - b. Dates and times work was performed, and by whom.
 - c. Time record, summary of hours worked, and hourly rates paid.
 - d. Receipts and invoices for:
 - 1) Equipment used, listing dates and times of use.
 - 2) Products used and listing of quantities.
 - 3) Subcontracts.
 4. Document Requests for Substitutions.
 5. Statement as to whether overtime work is, or is not, authorized.
- F. Approval or Rejection of Proposal.
1. When change is initiated by A/E or Owner through a COP.
 - a. Contractor to submit a detailed proposal in writing. Quotation will be guaranteed for period specified in Proposal Request beginning from signing of proposal. If no period is specified, guarantee quotation for sixty (60) days from signing.
 - b. Owner reviews proposal and responds in writing as follows:
 - 1) Request for additional information.

- 2) Proposal will be incorporated into a Change Order.
 - 3) Rejecting the proposal.
 - c. Contractor is not to proceed with work until a signed Change Order is received from the Owner.
2. When change is initiated by Contractor.
 - a. Owner reviews and responds in writing as follows:
 - 1) Agrees with Contractor's cost proposal;
 - 2) Request for additional information;
 - 3) Rejecting the proposal.
 - b. If the Owner responds by agreeing to the Contractor's change proposal, a Change Order will be processed.
 - c. If additional information is requested by Owner, respond in writing within fifteen (15) days of Owner's request.

1.05 CHANGE ORDER PROCEDURES

- A. Upon final agreement of costs and/or time on either an Owner COP, FA or a Contractor initiated proposal, a Change Order will be processed by E&AS.
 1. The Contractor can not submit an invoice for Work changes until a fully executed Change Order is completed.

END OF SECTION 01 26 00

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SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
- B. Requirements for Schedule of Values and Applications for Payment are also included in part 6 of the General Conditions For Washington State Facility Construction. This specification section includes additional detail regarding procedural requirements. In the event of conflicts between this specification and Part 6, the General Conditions shall supercede any requirements identified herein.

1.03 SCHEDULE OF VALUES

- A. Submit a list of all Subcontractors and Material Suppliers. Submit a copy of each Subcontractor's and Material Supplier's contract with the General Contractor, signed by both parties.
- B. The Schedule of Values and the Contractor's Construction Schedule are to be developed and agreed to with the Subcontractors.
 - 1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
 - a. Contractor's Construction Schedule.
 - b. Application for Payment forms, including Continuation Sheets.
 - c. List of subcontractors.
 - d. Schedule of allowances.
 - e. Schedule of alternates.
 - f. List of products.
 - g. List of principal suppliers and fabricators.
 - h. Schedule of submittals.
 - 2. Submit the Schedule of Values to the A/E for approval at the earliest possible date but no later than 30 days after the issuance of the Notice to Proceed, and not less than 14 days prior to the first application for payment.
- C. Use the Project Manual table of contents as a guide to format the Schedule of Values. Provide at least one line item for each listed Specification Section beginning with Division 2. Relate applicable activities of the Progress Schedule with each line item broken down separately for labor and materials. Include the following as a minimum:
 - 1. Include separate line item values for construction progress schedule and updates, mobilization, permits/bonds/insurances, temporary facilities, supervision, survey and layout, demobilization, commissioning and equipment/systems start-up, and project closeout retainage.

- a. General Conditions and Mobilization shall not exceed 3% of the Contract amount.
 - b. Demobilization shall be not less than 1% of the Contract amount.
 - c. Project closeout retainage value, for duration between Substantial Completion and Final Acceptance, shall be not less than 2% of the Contract amount. Of that amount, 1% shall be for "Punchlist Work". This amount will not be released until Final Completion is reached.
 - 1) This closeout retainage shall be in addition to the 5% retainage withheld under General Conditions item 6.04, and shall be for the purpose of protection of the Owner in the completion of any outstanding items on the Final Acceptance Punch List, and for reimbursing the Architect and their consultants for additional 'punch list' re-inspections beyond the first re-inspection; refer to Section 01 7700.
 - d. Schedule preparation and updates shall not be less than 1/2% of the Contract amount.
2. Major cost items, which are not directly a cost of actual work-in-place, such as distinct temporary facilities, may be either shown as items in the Schedule of Values or included in General Conditions and Mobilization or Demobilization at the Contractor's option.
 3. Line item amounts shall be rounded off to nearest whole dollar, with total of the primary schedule of values breakdown equal to the Contract Sum.
 4. Provide at least one line item for each Specification Section, and at least one line item for each pertinent item within each specification section.
 5. No line item of the Schedule of Values shall be greater than \$30,000 unless agreed to by E&AS Project Manager.
 6. Break down items of work that include both labor and material into those respective components.
 7. Provide breakdown by construction phasing or area of work.
 8. 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. Include requirements for insurance and bonded warehousing, if required.
 - b. Include separate line item cost for shop drawing preparation.
 9. Unit Cost Allowances: Show the line-item value of unit-cost allowances, as a product of the unit cost, multiplied by the measured quantity. Estimate quantities from the best indication in the Contract Documents.
 10. Margins of Cost: Show line items for indirect costs and margins on actual costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin for each item.
- D. Identify work, if any, to be performed by minority-owned business enterprises (MBE) and women-owned business enterprises (WBE).
- E. Identification: Include the following Project identification on the Schedule of Values:
1. Project name and location.
 2. Name of Architect.
 3. Project Number.
 4. Contractor's name and address.
 5. Date of submittal.
- F. Listing: Arrange the Schedule of Values in tabular form with separate columns indicating the following for each item listed:
1. Related Specification Section.
 2. Description of Work.
 3. Name of subcontractor.

4. Name of manufacturer or fabricator.
 5. Name of supplier.
 6. Change Order (numbers) that affect value.
 7. Dollar value.
 8. Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
- G. Schedule of Values Updating: Update and resubmit Schedule of Values prior to the next Application for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum. Add a new line item for each Change Order, and provide a breakdown of several line items for large or complicated Change Orders.

1.04 APPLICATIONS FOR PAYMENT

A. General:

1. Submit itemized payment request as required in General Conditions together with Schedule of Values and other submittals as listed herein.
 2. Except as otherwise indicated, sequence of progress payments is to be regular, and each must be consistent with previous applications and payments; it is recognized that certain applications involve extra requirements, including initial application, application at times of Substantial Completion, and final payment application.
 3. Contractor shall not "project" work completed beyond the date of Application for Payment submittal for the purpose of payment request.
- B. Each Application for Payment shall be consistent with previous applications and payments as certified by the A/E and paid for by the Owner.
1. If the Contractor withholds any portion of a previous payment from a subcontractor or material supplier, other than normal retainage, the Contractor shall provide a letter to the A/E with the next Application for Payment stating the reasons for withholding the payment.
- C. Payment Application Times: Progress payments will be based upon a monthly period, with the 24th day of each month being the cut-off date. The new payment period will then begin on the 25th of each month.
- D. Draft Payment Application: Draft copies shall be provided to the A/E and Owner at least 48 hours prior to the last regular construction meeting of the month at which the payment request will be reviewed. The draft payment request shall be a copy of the previous month's approved payment request, with proposed percentages and dollar amounts (rounded off to nearest whole dollar) hand written beside each line item, and a total percentage complete and dollar amount for the month. Once the amounts are reviewed and agreed to by the A/E and Owner, the Contractor shall prepare the actual payment request as required in this section based upon the amounts agreed to.
1. Have available for A/E review current Project Record Documents delineating any and all revisions since the previous application for payment.
- E. Application Preparation: Complete every entry on the actual payment request form. The A/E will return incomplete applications without action.
1. Entries shall match data on the Schedule of Values and the Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders issued prior to the last day of the construction period covered by the application. If a Change Order includes more than one Change Order Proposal (COP) or Field Authorization (FA), list each COP or FA individually.
- F. Transmittal: Submit electronic or paper copy of each Application for Payment to the A/E by a method ensuring receipt within 48 hours.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application, in a manner acceptable to the A/E.
- G. Initial Payment Application: The principal administrative actions and submittals which must precede or coincide with submittal of first payment application can be summarized as follows, but not necessarily by way of limitation:

1. Submit Statement of Intent to Pay Prevailing Wages on Public Works Contract on form issued by the State of Washington, Department of Labor and Industries. One is required from the Contractor and one from each of those subcontractors who will provide labor on the project site.

When these forms have been filled in, the Contractor shall send them to the Industrial Statistician in Olympia for certification. After certification, three copies will be returned to the Contractor. The Contractor shall forward the Owner's copy directly to the PM (do not send through the A/E). The Contractor shall also post on the project site one certified copy of each Statement of Intent. For further information, phone the Industrial Statistician (360) 902-5335.

Processing of an application will not begin until an approved copy is on file with the Owner for each classification of laborers, workers, or mechanics employed by the Contractor or Subcontractor that are included in an application for payment; no exceptions.

2. Submit and receive review comments for latest construction schedule.
3. Submit Schedule of Values, allocated to the various portions of the work; the schedule shall be used as a basis for the Contractor's Application for Payment.
4. List of Subcontractors, complete with phone numbers, business address and contact person.
5. List of major material suppliers and fabricators, complete with phone numbers, business address and contact person.
5. Contractor's Progress Schedule (preliminary if not final).
6. Schedule of Unit Prices, as applicable.
7. Schedule of Submittals (preliminary if not final).
8. Listing of Contractor's staff assignments and principal consultants.
9. Copies of acquired building permits and similar authorizations and licenses from governing authorities for current performance of the work.
10. Initial progress report.
11. Initial settlement survey and damage report, if required.
12. Quality Control Plan.
13. Safety Plan.
14. MWBE participation listing.
15. Waste Management Plan.
16. List of emergency contact information.
17. Other documents as may be required in the Contract Documents.

H. Applications each Month During Construction:

1. Submit itemized application, in number of copies as specified herein, each with waivers of mechanics liens from principal subcontractors, sub-subcontractors and suppliers as specified below.
2. Applications are to be signed by a responsible officer of Contracting firm. Do not sign in black ink; no photocopies or signature permitted.
3. Application for Payment shall include the following:
 - a. Application and Certificate for Payment on Contract.
 - b. State of Washington Invoice Voucher.
 - c. Invoice Voucher - Escrow.
 - d. Certificate for Material Stored on Job Site.
 - e. Invoices for materials stored off site, as applicable.

- f. Updated Construction and Submittal Schedules: If substantial changes have occurred in the Project Construction Schedule, or if enough changes have occurred that the schedule is rendered inaccurate or ineffective, submit with Application For Payment a revised updated Construction Schedule for evaluation and measurement of actual work-in-place with said application for payment, together with updated submittal schedule. If the Contractor does not submit a revised schedule with a payment request it is agreed by the Contractor that the project is still on schedule according to the last submitted schedule.
 - 1) If actual work completed is more than 14 days behind schedule, submit a recovery schedule per requirements of Section 01 32 16, Construction Progress Schedule, subparagraph 3.04C.4.b.
 - 4. When A/E finds Application for Payment properly completed and correct, the A/E will sign and transmit all copies of Application for Payment to Owner for processing.
 - 5. If A/E or Owner find Application for Payment improperly or incorrectly executed, an annotated copy will be returned for a NEW SUBMITTAL.
 - 6. Only minor corrections are allowed, with approval of Owner.
- I. Application at Time of Substantial Completion: See Section 01 77 00 for principal administrative actions and submittals which must precede or coincide with such special applications.
- 1.05 PAYMENT FOR STORED MATERIAL
- A. See General Conditions for Washington State Facility Construction Article 6.03.
- 1.06 SUBSTANTIATING DATA
- A. When A/E requires substantiating information, submit data in a timely manner justifying line item amounts in question.
- 1.07 APPLICATION FOR FINAL PAYMENT
- A. Application for a FINAL pay request will be accepted for processing only after satisfactory completion of the following:
 - 1. Punchlist items complete and accepted;
 - 2. Agreement on all Change Order costs;
 - 3. Required permits signed off;
 - 4. Submittal of Record Documents (as-builts);
 - 5. Submittal of approved O&M Manuals;
 - 6. Submittal of Warranty Manuals;
 - 7. All training has been provided to Owner's designated staff and signed rosters of those attending submitted to the PM.
 - 8. All security badges and building keys have been returned.
 - 9. Other requirements as specified in Section 01 77 00, Closeout Procedures.
- 1.08 RELEASE OF RETAINAGE
- A. Pursuant to the completion of Workperformed in accordance with a public works contract and Final Acceptance by the Owner, the following requirements must be satisfied to allow the release of retained contract funds at the earliest possible date.
 - 1. All Contract Closeout items have been reviewed by the A/E, any corrections made by the Contractor, and final copies received by the Owner.
 - 2. The A/E maintains a Construction Completion Checklist of requirements for completing the project. When the A/E determines that the checklist has been completed, the A/E consults with E&AS for concurrence that all requirements have been met for establishing Final Completion.

3. If there are no outstanding items required of the Contractor on the Construction Completion Checklist, the A/E provides a letter to the Owner with a copy to the Contractor that to the best of its knowledge, information, and belief, the Contractor has reached Final Completion on the project in conformance with the Contract Documents.
4. E&AS sends the Owner its Notification of Project Completion for the Owner's signature and return to E&AS.
5. Upon receipt of the signed Notification of Project Completion, E&AS issues its Completion Notice.
6. E&AS sends the Department of Revenue its Notice of Completion of Public Works Contract and sends the Contractor written notice of Final Acceptance.
7. Certificate of Payment of State Excise Taxes by Public Works Contractor. Following receipt of Owner's notice of completion and after determining that all taxes, increase and penalties due from Contractor have been paid, the Department of Revenue will issue this certificate to the Owner, releasing the state's lien on the retained percentage.
8. Certificate of Payment of Contributions, Penalties and Interest on Public Works Contract. Upon receiving a copy of the Owner's notice of completion from the Department of Revenue and determining that the Contractor is in compliance with the provisions of the Employment Security Act, the Employment Security Department will issue this certificate to the Owner, releasing its lien on the retained percentage.
9. Request for Release. This form must be completed by the Contractor and mailed to the Department of Labor and Industries, Industrial Insurance division, Contract Release Section, Olympia, Washington 98504. One copy of the Contractor's request for release, including attached list of Subcontractors, shall be transmitted to Owner.
10. Certificate of Release. Upon receipt of Contractor's request for release and verification from its records that the industrial insurance and medical aid premiums have been paid by Contractor and each Subcontractor, the Department of Labor and Industries will so note on its internet site. E&AS will review L&I's internet site for status compliance. Once full compliance is noted, it is confirmation that L&I does not hold a lien against the project.
11. At the time E&AS sends the Contractor written notice of Final Acceptance, it advertises the acceptance of the project which begins the forty five (45) day period for liens to be filed.
12. At the end of the forty five (45) day period, releases have been received, or confirmed, and there are no liens filed that have not been released, the retainage will be released.
 - a. If the retainage was placed in an escrow account, E&AS will notify the escrow company that the retainage may be released. No invoice billing from the Contractor for the retainage is required.
 - b. If the Contractor has elected to not put the retainage in escrow, an invoice for the retainage amount must be submitted and processed to allow release of the retained money.

END OF SECTION 01 29 00

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 – GENERAL

1.01 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.

1.02 SUMMARY

- A. The complexity of accomplishing a renovation project in and adjacent to an occupied and fully operational building requires that careful planning and coordination be developed and followed to accomplish the work. This planning and coordination shall minimize disruption to operations and allow involved parties to anticipate construction activity and to integrate other contract(s) with this Project.
- B. Coordinate scheduling, submittals and work identified in the Contract to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.
- C. Coordinate work between all Sections of Contract Documents to avoid conflicts and omissions. Take special care to coordinate work indicated as Architectural, Mechanical, Electrical and other major Divisions of the Contract Documents.
- D. Responsibility
 1. The Contractor shall be in charge of this Contract and the site, as well as the directing and scheduling of all Work. Contractor shall be on site at all times work of this Contract is in progress. Do not delegate responsibility for coordination to any subcontractor.
 2. Anticipate interrelationship of all subcontractors and their relationship with the total Work.
 3. Resolve differences or disputes between subcontractors and materials suppliers concerning coordination, interference, or extent of Work between Sections. Contractor's decisions, if consistent with Contract Document requirements, shall be final.
 4. Final responsibility for the performance, interface, and completion of the Work and the Project in accordance with the Contract Documents shall be with the Contractor.

1.03 SPECIAL COORDINATION

- A. There are occupied spaces outside of the limits of construction. These spaces will not be vacated for construction during this contract. Any work in these surrounding areas must be coordinated with the Owner.
- B. Additional special requirements and conditions apply to the work of this contract. Refer to Section 01 50 00 for detailed description of these additional requirements and conditions.
- C. The Owner may require access to the site to perform work related or unrelated to the project. The Contractor shall coordinate with the Owner to accommodate such work within the contract time.

1.04 CONSTRUCTION ORGANIZATION

- A. Construction Mobilization
 - 1. Cooperate with the Site Representative in allocation of mobilization areas of site; for field offices and sheds, for access, traffic and parking facilities.
 - 2. During construction, coordinate use of site and facilities through Site Representative.
 - 3. Comply with Architect and Site Representative's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
 - 4. Coordinate field engineering and layout work under instructions of Site Representative.
- B. Coordination Of Submittals
 - 1. Schedule and coordinate submittals specified in the Contract Documents.
 - 2. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to and placing equipment in service.
 - 3. Coordinate request for substitutions to assure compatibility of space, operating elements, and effect on work of other Sections.
- C. Coordination & Pre-Installation Meetings: Refer to Section 01 31 19, Project Meetings.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

3.01 COOPERATION & COORDINATION OF WORK

- A. The Contractor is responsible for the coordination of the work of all trades; coordinating the installation of their work and that of all subcontractors to ensure compliance with the Contract Documents and to expedite the progress of the Project. Contractor shall check specifications, addenda, and drawings covering all trades as the work progresses. Contractor shall promptly report to the Architect what they consider omissions, conflicts or points requiring clarification.
- B. Contractor shall prepare and distribute to each entity performing work at project site, a written memorandum of instructions on required coordination activities, including required notices, reports and attendance at meetings.
- C. It is the responsibility of the Contractor to ensure that the work of subcontractors complies with Conditions of the Contract, Division 1 - General Requirements, and the work of other Sections related to their own work. No additional payments or time extensions will be authorized for failure on the part of subcontractors to be familiar with and in compliance with the aforementioned specification divisions and sections.

3.02 PROJECT COORDINATION & SCHEDULING CONTROL

- A. The Contractor shall schedule and coordinate the work of all subcontractors on the project including their use of the site. Responsibility for coordination and close adherence to time schedules rests solely with the Contractor who shall maintain coordination and scheduling control at all times.
- B. Each subcontractor responsible to the Contractor shall cooperate diligently with the Contractor in the execution of their work so as to cause no delay in the completion of the Project. This responsibility includes the completion of all work in a timely manner.

- C. Changing Subcontractors: The General Contractor shall be responsible for all the additional expenses incurred by changing subcontractors during the course of this project. These additional expenses include, but are not limited to, the engineering expenses for revised submittal, request for information, or any clarification or duplication that might occur due to the fact that the initial documents have been revised.

3.03 MECHANICAL AND ELECTRICAL COORDINATION

- A. All mechanical subcontract work (insulation, plumbing, fire sprinkler, air distribution, sheet metal, steam, balancing and controls, etc.) on this project, shall be the sole responsibility of one Mechanical Subcontractor. In turn, this Mechanical Subcontractor shall answer to the General Contractor. This Mechanical Subcontractor shall be responsible for coordination between the trades above to make sure that all the interface between the different mechanical subs are in place, assuring that all the above systems are in proper working condition.
- B. Coordination Of Space
 - 1. Coordinate use of Project space, including structural and architectural elements, and sequence of installation of fire suppression, plumbing, HVAC, communications, security and all other electrical work which is indicated diagrammatically on Drawings. Follow routings shown for pipes, ducts and conduits as closely as practicable, with due allowance for available physical space; make runs parallel with lines of building. Utilize space efficiently to maximize accessibility for other installations, for maintenance and for repairs.
 - 2. In finished areas, except as otherwise shown, conceal pipes, ducts, wiring and the like in the construction. Coordinate locations of fixtures and outlets with finish elements.
- C. Resolve all "tight" or restricted conditions involving work of various sections in advance of installation of mechanical and electrical work.
- D. Prior to proceeding with work in these areas, Contractor shall be responsible for preparing supplementary drawings for review showing all Work in "tight" areas, and provide minor adjustments and additional work necessary to overcome "tight" conditions, at no increase in Contract Sum. "Tight" areas shall be identified by the Contractor, however, the Owner reserves the right to require supplementary drawings for any areas affected by the construction activity whether or not identified as "tight" by the Contractor. ("tight" shall be defined here as "a condition so close in structure as to prevent passage; allowing little or no room for free motion or movement.")
- E. Equipment Connections: Refer to Section 01 11 00 and to General Requirements in the various Mechanical and Electrical Divisions. Work includes but is not limited to:
 - 1. Provide motors and equipment for current characteristics as shown on Electrical drawings:
 - a. Electrical Contractor:
 - 1) Electrical Contractor shall furnish and install all wiring except:
 - a) Temperature control wiring.
 - b) Equipment control wiring.
 - c) Interlock wiring.
 - 2) The Electrical Contractor shall furnish and install all power wiring complete from power source to motor or equipment junction box, including power wiring through starters. After all circuits are completed, Electrical Contractor shall be responsible for all power wiring.

- b. Mechanical Contractor: Mechanical Contractor shall, regardless of voltage, furnish and install all temperature control wiring, all starters not factory mounted on equipment, and all interlock wiring and equipment control wiring for the equipment that the Mechanical Contractor furnishes.

3.04 JOB SITE FIELD MEASUREMENTS AND TEMPLATES

- A. Obtain field measurements required for accurate fabrication and installation of Work included in this Contract. Exact measurements are the Contractor's responsibility.
- B. Contractor shall be responsible for field verifying actual dimensions where "+/-" dimensions are indicated.
- C. Furnish or obtain templates, patterns, and setting instructions as required for installation of all Work. Verify all dimensions in the field.

3.05 DIMENSIONS

- A. The Architectural Drawings are to be used in conjunction with the Plumbing, Mechanical and Electrical Drawings. Not all secondary dimensions are shown, such as exact door and window locations, wall configurations, slab slopes and depressions, curbs, etc. Any dimensional discrepancies between the Architectural, Plumbing, Mechanical and Electrical drawings shall be reported to the Owner's Representative and A/E before proceeding with the work.

3.06 INTENT OF DRAWINGS

- A. The work of the Contractor and subcontractors shall conform to the intent of the architectural and coordination drawings as reviewed by the A/E. Drawings are partly diagrammatic and do not intend to show in details all features of work. The Contractor shall carefully review the work to be performed by other trades, compare related drawings and shall thoroughly understand the building conditions affecting their work.
- B. All changes required in the work caused by failure to do so shall be at no expense to the Owner.

3.07 NOTIFICATION & CORRECTION OF DEFECTIVE WORK

- A. Coordinate the Work of all subcontractors and make certain that, where the work of one trade is dependent upon the work of another trade, the work first installed is properly placed, installed, aligned and finished as specified or required to properly receive subsequent materials applied or attached thereto.
- B. Direct subcontractors to correct defects in substrates they install when subcontracts of subsequent materials have a reasonable and justifiable objection to such surfaces. Promptly notify the Owner's Representative and Architect of any defects or imperfections in preparatory work which will in any way affect satisfactory completion of the work.
- C. Under no condition shall a section of work proceed prior to preparatory work having been completed, cured, dried or otherwise made satisfactory to receive such related work. Do not force subcontractors to apply or install products to improperly finished product.
- D. Correction of defective work shall be the responsibility of the Contractor or subcontractor providing the defective work. Correction of work due to underlying defects shall be the responsibility of the Contractor or subcontractor providing overlying work.

END OF SECTION 01 31 00

SECTION 01 31 15

COMMUNICATION

PART 1 - GENERAL

1.01 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.

1.02 GENERAL COMMUNICATION

- A. Telephone communication and correspondence shall be between Contractor's Representative and A/E.
- B. Subcontractors are not to contact members of the design team directly unless explicitly agreed to by Contractor, A/E and PM. All such contact and discussions are to be documented in writing by the subcontractor and submitted to the A/E and PM through the Contractor.
- C. The General Contractor shall transmit problems or questions in writing using a Request for Information (RFI).
- D. On-Site Lines Of Authority & Communications: Establish on-site lines of authority and communications including attendance at Pre-Construction Meeting and Progress Meetings as required by the A/E and Owner's Site Representative. All on-site lines of authority and communications shall be established through the A/E.
- E. The A/E and PM will not typically be working during the Contractor's normal working hours as defined in Section 01 01 00. The Contractor shall anticipate that all communication and weekly construction meetings with these parties will occur between the hours of 8:00 a.m. and 5:00 p.m. Monday through Friday throughout the duration of the Project.
- F. The Contractor shall incorporate any cost affect this may have on the progress of the Project into his Base Bid. No overtime payments will be authorized, or time delays allowed, for the Contractor or subcontractors to communicate with the A/E and PM outside of the Contractor's normal working hours.

1.03 EMERGENCY COMMUNICATION

- A. An Emergency list will be established.
 - 1. The Contractor shall provide a list of names, pagers, wireless and wired telephone numbers of staff who are capable of addressing an emergency issue that may occur outside of Contractor's normal working hours. The persons designated on the list shall be available at the project site within 30 minutes of being contacted. Provide two names for each of the following:
 - a. General Contractor
 - b. Mechanical Subcontractor
 - c. Electrical Subcontractor
 - d. Fire Protection Subcontractor

- e. Demolition Subcontractor
- 2. Submit the list to the A/E 5 working days prior to the Preconstruction Meeting. The A/E will include the same information for design team members and Owner representatives and distribute the list at the Preconstruction Meeting.

1.04 CORRESPONDENCE

- A. All correspondence to and from Contractor will be routed through A/E with a copy to PM.
- B. Include project title and project number on all correspondence.

1.05 REQUEST FOR INFORMATION (RFI)

- A. It is the Contractor's responsibility to review Contract Documents in a timely manner so that the A/E shall have sufficient time to respond to a Request for Information prior to the start of actual construction of that part of the Work.
- B. When field conditions or Contract Document contents require clarification or verification by the A/E or A/E's sub-consultants, a written RFI is to be submitted as follows:
 - 1. Identify the nature and location of each clarification/verification using a RFI form; provide as a minimum the following information:
 - a. Project name and number;
 - b. Date;
 - c. Date response desired.
 - d. RFI number;
 - e. Subject;
 - f. Initiator of the question;
 - g. Indication of costs, if known;
 - h. Location on site;
 - i. Contract drawing reference;
 - j. Contract specification section and paragraph reference;
 - k. Descriptive text;
 - l. Space for reply on same page as questions; and
 - m. Single subject matter, 1 item each - architectural, civil, structural, mechanical, electrical
 - 2. Number each RFI sequentially beginning with number 001 (RFI-001). Only one question per RFI.
- C. Uses
 - 1. The RFI form shall be used for interpretation or clarification of the Contract Documents only.
 - 2. Do not use the RFI form for the following; the A/E will not reply and the RFI will be returned without action:
 - a. Product or material substitution.
 - b. Questions relating to construction means, methods, techniques, sequences, procedures, or safety precautions. These are the Contractor's responsibilities exclusively.
 - c. Questions relating to construction schedule, coordination between trades, or division of work among subcontractors. These are Contractor's responsibilities exclusively.
 - d. Questions on contract administration procedural matters, unless they require interpretation or clarifications of the Contract Documents.
 - e. Dimensions or quantities which are shown on the Contract Documents, which can be measured or calculated from the information contained in the Contract Documents where such measurement or calculation is standard construction industry practice.

- f. Confirmation of interpretations or clarifications previously provided by the A/E.
 - g. The Contractor shall not initiate requests for interpretations or clarifications of the Contract Documents which can be reasonably derived from a review of the Contract Documents.
- D. Route: RFI's in same manner as correspondence
- E. Clarifications may be discussed on-site or by telephone with A/E or A/E's Consultant with concurrence of the A/E. The essence of these discussions are to be incorporated into a RFI form and submitted for normal RFI processing.
- F. Reply
- 1. The A/E will endeavor to reply to all RFI's promptly as his work schedule allows and generally no later than 7 working days from the day received. The consultant will expedite those RFI's indicated by the contractor as being critical to the construction process.
 - 2. When an RFI involves a complex subject, extensive research or governmental agency contact, the A/E will inform the Contractor that additional time is required to prepare a reply. The Contractor shall cooperate and agree to reasonable additional time.
 - 3. The reply shall be a clarification or an interpretation of the Contract Documents; the reply is not an authorization of change in the Contract Sum or Time.

1.06 NON-COMPLIANCE NOTICE (NCN)

- A. Any work that is identified as not in compliance with the Contract Documents, either by oral discussion with the contractor, or written communication to the contractor, shall be removed and replaced without cost to the Owner, including removal of additional material necessary to confirm non-compliance. At its option, the Owner may accept written alternative solutions by the contractor and recommended by the A/E. The Contractor shall notify the A/E and Owner in writing immediately following oral discussion or receipt of any written communication if the contractor believes they are in compliance with the Contract Documents. The A/E will make a determination based on the Contract Documents. If the A/E finds the work is in non-compliance the A/E will issue a written Non-Compliance Notice (NCN). Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. Upon receipt of the NCN, the Contractor shall take immediate action to correct work. Review corrections at progress meetings for closure.
- B. If the Contractor fails or refuses to comply promptly after the final determination of the appropriate corrective action, the Owner may:
- 1. issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Owner will not pay for non-complying work or follow on work until the non-complying work is corrected or replaced. If it becomes necessary to stop work due to non-correction or non-complying work, no delay claim, time extension, or compensation will be granted, or
 - 2. the Owner may elect to correct the non-compliant work and back charge the Contractor by a deductive Change Order

END OF SECTION 01 31 15

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SECTION 01 31 19

PROJECT METINGS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:
 - 1. Preconstruction meeting;
 - 2. Progress meetings;
 - 3. Pre-installation meetings prior to starting certain work;
 - 4. Project closeout meetings;
 - 5. Owner training meetings.

1.03 PRECONSTRUCTION MEETING

- A. The Owner will schedule a preconstruction conference before starting construction, at a time convenient to the Contractor and the A/E, but no later than 15 days after the Notice To Proceed. The conference will be held at the Project Site or another convenient location as selected by Owner.
- B. Attendance is required of the following:
 - 1. A/E and A/E's consultants;
 - 2. Owner's Representatives;
 - 3. E&A Services Project Manager;
 - 4. Contractor's Superintendent and Project Manager; Contractor's QC Representative if different individual than the Project Manager.
 - 5. Major Subcontractors;
 - 6. Others, as requested; e.g., Barrier-Free Facilities Program Manager.
- C. Discussion will cover items of significance, including the following:
 - 1. Communication chain and persons authorized to direct changes;
 - 2. The Work;
 - 3. Site Representative's roles;
 - 4. Work hours, sequence, phasing, and occupancy;
 - 5. Special project procedures;
 - 6. Procedures and processing:
 - a. Application for payments;
 - b. Change Order Proposals (COP);
 - c. Field Authorizations (FA);
 - d. Change Orders (CO);
 - e. Requests for Information (RFI);
 - f. A/E Supplemental Instructions (ASI)
 - g. Field decisions;

- h. Submittals;
 - i. Universal Design;
 - j. Others as appropriate.
- 7. Project record documents including review of as-builts on a regular basis during construction;
 - 8. Construction facilities, and controls;
 - 9. Temporary utilities;
 - 10. Security procedures;
 - 11. Housekeeping procedures;
 - 12. Utility shutdowns / Outage Request Form;
 - 13. Parking;
 - 14. Equipment deliveries and priorities.
 - 15. Schedule Review;
 - 16. Contractor's Quality Control System:
 - a. CQC Representative
 - b. CQC daily report
 - 17. Hazardous material abatement procedures, if any.
 - 18. Use of site and premises by Owner and Contractor.
 - 19. Others, as appropriate.

D. The A/E will:

- 1. Conduct the meeting to review contract administration requirements.
- 2. Record, produce, and distribute copies of the minutes to the PM and General Contractor within seven (7) days of the meeting.

E. The General Contractor shall be responsible to distribute copies to all other Contractor attendees.

1.04 PROGRESS MEETINGS

- A. For purposes of coordination and scheduling after start of the work, weekly Progress Meetings will be held to enable an orderly review of the construction progress and to provide for systematic discussion and analysis of concerns that may arise relative to execution of the work.
- B. Contractor, and Subcontractors as required, shall incorporate attendance at these meetings as part of the Base Bid of the project – no overtime payments will be authorized for Contractor or Subcontractors to attend weekly Progress Meetings or other special meetings if required.
- C. Meeting Locations: ADA accessible Contractor's project field office or Owner provided meeting room, unless otherwise agreed.
- D. Attendance: Representatives attending meetings are required to be qualified and authorized to act on behalf of their firms. Attendance shall include:
 - 1. A/E and A/E's consultants, as appropriate;
 - 2. Owner's Representatives;
 - 3. E&A Services Project Manager;
 - 4. Contractor's Superintendent, Project Manager, and QC Representative;
 - 5. Subcontractors, as appropriate;
 - 6. Suppliers, as appropriate;
 - 7. Others, as appropriate; e.g., Barrier-Free Facilities Program Manager.
- E. Agenda: Discussion will pertain to items, such as:
 - 1. Attendees; list of attendees and company they represent;

2. Review and approve minutes of previous meeting; written corrections, additions and/or deletions to previous minutes acknowledged;
3. Review Short Interval Schedule;
4. Review Outages;
5. Review construction schedule; confirm current status of work;
6. Present corrective measures and procedures to regain project schedule, as applicable;
7. Present field observations, problems, and conflicts; discuss concerns pertaining to:
 - a. Civil items.
 - b. Structural items.
 - c. Mechanical items.
 - d. Electrical items.
 - e. Architectural items.
8. Discuss problems impeding progress schedule;
9. Review Contractor's quality control system; discuss any concerns and corrective measures.
10. Review submittal schedules and logs, present methods to expedite as required;
11. Review off-site fabrication;
12. Review delivery schedules;
13. Review outstanding RFIs;
14. Review proposed changes for:
 - a. Effect on construction schedule and on completion date.
 - b. Effect on any other contracts of the project,
15. Review Change Order Proposal log and finalize prices;
16. Review draft of Application for Payment (at end of month);
17. Confirm status of the "as-built" drawings and review required revisions to Project Record Documents; see update requirements specified below;
18. Confirm status of shop drawing submittals and approvals.
19. Review project safety;
20. Review any outstanding Non-Compliance Notices;
21. Review any tenant impacts.
22. Review any other business.
23. Confirm next meeting date, location and time plus those requested to be in attendance.

F. A/E will:

1. Administer weekly Progress Meetings throughout work progress;
2. Record and distribute the following by e-mail within 3 working days after the meeting. Minutes, RFI, ASI, Submittal/Shop Drawing and Cost Change logs. Distribution to include all attendees other than those related to the General Contractor's contract. The General Contractor is responsible to distribute copies to all Contractor attendees.
3. Provide paper copies of the minutes, RFI, ASI, Submittal/Shop Drawing and Cost Change logs to attendees at the next meeting.
4. Ascertain that work is prosecuted consistently with contract documents and construction schedules.

G. Contractor shall be responsible to provide the following at each meeting:

1. Current (and updated if necessary) construction schedule which includes the past week and 2 week 'look ahead'.
2. One set of record documents (drawings, specifications, COs, COPs, RFIs, FAs, etc.).
3. Current (and updated if necessary) submittal schedule.
4. Current (updated) set of "as-built" Project Record Documents.

1.10 PROJECT CLOSEOUT MEETINGS

- A. For the purpose of attaining project closeout, commencing immediately following established date of Substantial Completion, Contractor's project manager and superintendent and all subcontractors who have outstanding punch list items associated with their work, or as otherwise requested and including all subcontractors involved in the building systems commissioning process, shall attend weekly closeout meetings which shall be held at the jobsite.
- B. Such meetings shall be held to review and discuss the resolution of all punch list items in order to attain Final Completion. Closeout meetings shall continue on a weekly basis until all punch list items have been resolved and Final Completion is attained.

1.11 TRAINING MEETINGS FOR OPERATING INSTRUCTIONS OF OWNER'S PERSONNEL

- A. Refer to Section 01 77 00 for training requirements related to operating instructions of Owner's personnel.

1.12 ADDITIONAL MEETINGS

- A. As the construction progresses, additional meetings may be required. These may be called at the direction of or by the A/E or PM.

END OF SECTION 01 31 19



Request for ALSC Architect’s Electronic Drawing File(s).

Directions

To request electronic drawings, please fill out this form in its entirety, including signature and payment, and mail to: ALSC Architects, 203 N. Washington, Suite 400, Spokane, WA 99201-0254. Upon receipt, and ALSC’s approval the request is reasonable, the information will be assembled. Please note: Payment of an administrative fee of \$75 per request to ALSC Architects is required before the information will be made available. Unfulfilled requests will be refunded.

Requests for consultant information (structural, mechanical, electrical, civil, etc.) will need to be directed to the office of the consultant noted on the title sheet of the construction documents.

ALSC Job Name

ALSC Project Architect

Person Making Request

Company Name

Contact Phone Number

E-mail Address or Mailing Address

Delivery Request: Pickup at ALSC Architects E-mail delivery Other

Notice

Notice to the Corporation, Person and/or Persons regarding the Electronic Drawing (CADD or BIM) files enclosed. Acceptance of this electronic data is based on the following disclaimer, which covers all CADD data received from ALSC Architects, including BIM Models.

Disclaimer

ALSC Architects makes no representation or warranties, express or implied, with respect to the use of the data provided herewith, regardless of its format to the means of its transmission. There is no guarantee or representation to the user as to the accuracy, currency, suitability or reliability of this data for any purpose. The user accepts, by signature below, the data “as is,” and assumes all risks associated with its use. By acceptance of this data, the user agrees not to transmit this data or provide access or any part of it to another party unless the user shall include with the data a copy of this disclaimer. ALSC Architects assumes no responsibility for actual or consequential damage incurred as a result of any user’s reliance on this data.

Signature of Person Making Request *(unsigned requests will not be processed)*

Drawing Sheet(s) and/or Files Requested

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. This section supplements General and Supplemental Conditions requirements and specifies administrative and procedural requirements for preparation of a preliminary Construction Schedule, Contractor's final master Construction Schedule, hereinafter called the Construction Schedule, Short Interval Schedules ('look-ahead'), and monthly updates.
2. The provisions and requirements of this Section supersede those contained in Article 3.02 of the General Conditions, as supplemented, where said provisions or requirements are in conflict.

B. Definitions:

"Day", as used throughout the Contract unless otherwise stated, means "calendar day".

1.02 SYSTEM DESCRIPTION

A. System Requirements: The purpose of the schedules and reports is to:

1. Ensure adequate planning and execution of the work by the Contractor so that it is completed within the milestone dates and total number of working days allowed in the Contract.
2. Establish the standard against which satisfactory completion of the project shall be judged.
3. Assist the A/E and Owner's Representative in monitoring progress.
4. Assess the impact of any changes to the Contract.
5. Support the basis for progress payments.

B. Float or Slack Time in the Schedule:

1. Float time is defined as the amount of time between the earliest start date and the latest start date or between the earliest finish date and the latest finish date of an activity or chain of activities on the 'Critical Path Method' (CPM) Construction Schedule.
2. Joint Ownership of Float: The Contractor's construction schedule will begin with the date of issuance of Notice to Proceed and conclude with the date of Substantial Completion of the Project, which is the Time of Completion indicated in the Bid Proposal. Float or slack time within this construction schedule is not for the exclusive use or benefit of either the Owner or the Contractor, unless otherwise identified in these Contract Documents, but is a jointly owned project resource available to both parties as needed to meet Contract milestones and the Contract Substantial Completion date. Any float time to activities not on the critical path shall belong jointly to the Contractor and Owner, and may be used by the Contractor and Owner throughout the construction process. However, the Contractor and Owner can mutually reserve and apportion float time according to the needs of the Project.
3. Limited Damage for Delay:

- a. No time extensions will be granted nor delay damages paid until a delay occurs that impacts the project's critical path, consumes all available float or contingency time available, and extends the work beyond the specified contract completion date.
 - b. Any float time remaining at the established date of Substantial Completion shall belong to the Owner, and may be used by the Owner in determining if additional contract days are to be awarded for changes in the Contract or for delays to the Contract caused by the Owner. The Contractor shall not be entitled to any adjustment in the Contract Time, the Contract Schedule, or the Contract Price, or to any additional payment of any sort by reason of the Owner's use of any float time remaining between established date of Substantial Completion and the final completion date.
4. Non-Sequestering of Float: Pursuant to the float-sharing requirements of these Contract Documents, the use of float suppression or float hiding techniques such as preferential sequencing or logic, special lead/lag restraints, using multiple critical paths, scheduling activities which can be done concurrently as sequential activities on the critical path or artificially inflating the duration of activities on the critical path are prohibited and the use of float time disclosed or implied by the use of alternate scheduling techniques shall be shared to the proportionate benefit of the Owner and the Contractor. Sequestering of float shall be cause for rejection of Contractor's schedule submittal.
 5. Float Developed by Accelerated Actions of Owner or A/E: Float may be added to the Construction Schedule through the expedited activities of the Owner or the Architect. The Construction Schedule must show all scheduled Owner or A/E activities which can affect the critical path including submittal review, delivery of Owner provided items, testing or permit compliance reviews or inspections. Times for these activities on the Construction Schedule must reflect the maximum time or latest date of delivery/arrival indicated in the Specifications or Drawings. If no duration or delivery date is shown or specified, the schedule is to indicate reasonable dates and duration for those items. If A/E or Owner create float by doing activities ahead of schedule, this time will be identified each month and may be used to offset delays which may be caused by A/E, Owner or other delay occurrences outside of the Contractor's control.
- C. If the Contractor should desire or intend to complete the Work earlier than any required Milestone or Completion date, the Owner or A/E shall not be liable to the Contractor for any costs or other damages should the Contractor be unable to complete the Work before such Milestone or Completion date.

1.03 SUBMITTALS

- A. General: Comply with pertinent provisions of Section 01 33 00.
- B. All schedule submittals, including schedule updates, will be reviewed jointly by the A/E and the Contractor. Such review of the Contractor's schedules shall not constitute an approval or acceptance of the Contractor's construction means, methods, or sequencing or its ability to complete the Work in a timely manner. Neither the Owner's nor the A/E's review will relieve the Contractor of the sole responsibility for the accuracy, adequacy, or completeness of the schedule, the logic of the schedule, and/or completion of the Contract requirements in accord with such schedule. Neither Owner's nor A/E's review shall constitute acknowledgment that the relationships between various work items or activity durations are reasonable or appropriate.
- C. Preliminary Progress Schedule:
 1. Submit the Preliminary Progress Schedule to the Architect within fourteen (14) days after the Notice to Proceed.
 2. Re-submit the Preliminary Progress Schedule to the Architect until the schedule meets all requirements of this Section.
 3. Each submittal shall be in the form of three (3) copies of a computer plotted time-scaled logic diagram, sorted by activity number, early start and total float.

D. Progress Schedule:

1. Within twentyone (21) days after issuance of Owner's written Notice to Proceed, and before any progress payment need be made, the Contractor, after consultations and sign-offs with its major Subcontractors and Suppliers of any tier has been performed, shall submit a complete Contractor's Construction Schedule to the Owner and A/E for Owner's and A/E's review.
2. Initial submittal shall be in the form of one reproducible copy and three prints, in addition to providing CD-ROM of the baseline schedule.
3. The Owner and A/E will review the substance of Contractor's Construction Schedule and return to the Contractor with comments within ten (10) days. Within ten (10) days following return of reviewed Construction Schedule, the Contractor shall meet with the A/E to discuss Owner's and A/E's Schedule review comments and revisions to the Schedule.
 - a. Within ten (10) days following said meeting, Contractor shall submit a final Construction Schedule implementing all revisions as directed in the above noted meeting.
 - b. This submittal shall be in the form of four (4) colored copies of a computer plotted time scaled logic diagram sorted by activity identification number, early start, total float and indicating early and late starts, plus four (4) copies of the corresponding Schedule of Values. Provide the same for each update.
4. When submitting the final schedule, the Contractor shall include its cover letter of transmittal and include a statement that the schedule has been completed and concurred with by its subcontractors.
5. Progress Payment will be withheld until Contractor's Construction Schedule has been submitted in final form and content satisfactory to the A/E and Owner.

E. Periodic Updates to Progress Schedule:

1. Submit an Updated Progress Schedule with each request for a monthly progress payment as required in Part 3 of this Section.
2. Each submittal shall be in the form of one reproducible copy and three prints, in addition to providing a CD-ROM of each update version.

F. Distribution: Copies of reviewed schedule and every revision thereof shall be submitted to the A/E, the Owner, and to everyone whose time performance is essential to achieving the progress shown on the schedule.

PART 2 – PRODUCTS

- A. Required Data: Show complete sequence of construction by activity, indicating critical path of activities, including but not limited to:
1. Date for Notice to Proceed;
 2. Date for Substantial Completion;
 3. Project mobilization;
 4. Operating constraints and sequences specified by Owner;
 5. Shop Drawing, product data, samples, mock-up submittals and reviews, by specification section;
 6. Date for final color selections to not affect the Critical Path;
 7. Provide demolition schedule as indicated in the Construction Documents;
 8. Planned versus actual status for each Work activity;
 9. Material procurement - fabrication, delivery to job site, and installation - of equipment and critical materials;
 10. Fabrication of special material and equipment, its installation and testing;
 11. Utility shutdowns, road closures, etc.;

12. Any intermediate (milestone) completion dates identified in the Contract Documents; include coordination activities as milestones, such as utility tie-ins, outages, Owner furnished items, City inspections, etc.;
 13. Delivery windows for all Owner furnished items. Establish earliest and latest delivery dates in consultation with the manufacturer;
 14. Pre-Installation Meetings;
 15. Contractor transfer of any existing Owner equipment;
 16. Show interrelationships and dependencies including activities of separate contractors;
 17. Long lead items;
 18. Testing, commissioning, Owner training sessions, and other close out activities;
 19. Show Field Authorizations (FA) and Change Orders (CO) when they impact the critical path of the schedule;
 20. Punch list;
 21. Punch list corrections.
 22. Final cleanup.
 23. All activities by the A/E that affect progress, required dates for completion, or both, for all and each part of the Work.
- B. Number and Duration of Activities on the Network Analysis:
1. Treat each trade or type of work as a separate activity or set of activities on the network analysis. Each activity shall be coded for responsibility (Contractor, Owner, A/E, etc.), Subcontractor, Discipline (Fire Suppression, Plumbing, Mechanical, Automation, Electrical, Communications, Roofing, etc.). Each project phase (i.e., 1, 1-A, 2, etc.) shall be scheduled separately.
 2. At a minimum treat each section of the technical specifications as one or more trades or types of work.
 3. Treat submittal, fabrication, delivery, installation, and startup as separate activities for each trade, type of work and item of equipment, including any items procured under any early procurement contracts transferred and/or assigned by Owner, required for performance of Work. The fabrication and delivery activities shall have the appropriate logic ties to submittal/review and construction activities.
 4. Submittal and review activities for shop drawings, samples, etc., shall allow reasonable durations for preparation of submittals, submittal review, revisions and re-submittal review. Refer to Section 01 33 00 for specified durations for processing submittals by the Architect and its Consultants, or the Owner and its Consultants, as applicable. Shorter review times for critical submittals may be negotiated on an individual basis. Re-submittals shall have the same review times allotted as the initial submittals. Re-submittal of shop drawings or samples necessitated by required corrections shall not be cause for extension of time. If certain submittals are critical, they shall be so identified at the time of submission to assure priority treatment. The submittal activities shall have the appropriate logic ties to delivery and construction activities.
 5. No activity or task shall be longer than 15 calendar days duration, with shorter durations if they affect other activities. The activities shall show early and late start, early and late finish, and float dates. Break down major tasks into sub-tasks or by area to meet this criteria.
 5. Where activities extend more than 15 days divide activities into logical component activities.
 6. Show on the diagram, as a minimum for each activity, preceding and following event numbers, description of each activity, cost, and activity duration in calendar days.
- C. Baseline Schedule: The initial Schedule when reviewed by the A/E and Owner shall be identified as the Baseline Schedule and shall be known as Revision 0. Each subsequent reviewed change to the Schedule shall be as a Revision numbered in sequence (Revision 1, 2, 3, etc.). The Baseline Schedule shall be submitted with no progress percentages applied to activities. The first update shall include the preliminary schedule activities and remaining activities updated as of the second monthly pay request.

PART 3 – EXECUTION

3.01 PRELIMINARY CONSTRUCTION SCHEDULE

A. General:

1. Prepare and submit the Preliminary Progress Schedule to the Architect within 14 days after the Notice of Award, showing all elements itemized in 2.01B above.
2. The schedule shall have been developed by the Contractor in conjunction with its Subcontractors. Major subcontractors greater than 20 percent of the contract are required to review and sign off on the progress schedules as a condition to the Owner authorizing progress payment approval.

B. Re-submittal: Re-submit the Preliminary Construction Schedule to the A/E until the schedule meets all requirements of this section.

C. Scope of Preliminary Construction Schedule: The Preliminary Progress Schedule shall detail, at a minimum, all work which will be accomplished in the first 60 calendar days following the Notice to Proceed. The general approach of the balance of the work shall be indicated.

D. Limitation on Construction:

1. Mobilization and submittals can be in process during the review period.
2. No construction work shall be permitted until the Preliminary Construction Schedule is submitted and reviewed.

E. Initial Progress Payment: The first pay request will be based on the update of the preliminary schedule. This submittal shall be in the form of three (3) copies of a computer plotted time-scaled logic diagram, the accompanying Microsoft Project CD-ROM, and hard copy computer reports sorted by activity number, early start and total float.

3.02 COMPLETE CONSTRUCTION SCHEDULE

A. General: Submit the complete (Master) Construction Schedule to the A/E within fourteen (14) days following the Notice to Proceed.

B. Subcontractor Participation:

1. Involve all major subcontractors in preparation of the Master Construction Schedule.
2. Obtain approval of the schedule from each major subcontractor and submit in writing together with the final Construction Schedule.

C. Start-Up and Testing: Include adequate time for start-up and testing of the complete facility.

D. Progress Payments:

1. Shall be withheld in the absence of a reviewed Construction Schedule.
2. No adjustment or extension of time shall be granted for failure to meet the activity dates as shown. Failure to comply with these requirements shall be cause for rejection of any progress payments presented thereafter, until such time as these requirements are met.

E. Distribution: Copies of reviewed preliminary Construction Schedule and every reviewed revision thereof shall be submitted to the A/E, the Owner, and to everyone whose time performance is essential to achieving the progress shown on the schedule.

3.03 SHORT INTERVAL SCHEDULE

A. Prepare a 3-week Short Interval ("look-ahead") Schedule. Show one (1) prior week of actual progress (planned vs actual performance). Forecast two (2) weeks of start and completion dates for each activity, task or event in comparison to the prepared schedule.

1. Activities in the Short Interval Schedule shall relate directly to activities in the Construction

Schedule. Each activity shall be coded with the same ID number, specification number, or other reference the contractor uses on the Construction Schedule. The Short Interval Schedule will have more detail, but each of the details must be related to the Construction Schedule coding.

2. Indicate start, on-going, intermittent and completion for each activity, task, or event.
 3. The schedule shall show critical path work, as defined by the Construction Schedule, that has been affected by any changed conditions authorized through a change order or field order.
- B. Distribute paper copies of the Short Interval Schedule to all attendees at each weekly Progress Meeting.

3.04 UPDATES

A. General:

1. The scheduler shall attend all meetings concerning project progress, alleged delays, or time impact.
2. The schedule shall be modified to reflect the original Contract completion date, subject to review by the Owner. Prior to submittal of the schedule update, the Contractor shall submit an advanced worksheet indicating the intended report status. The Owner, A/E and Contractor shall then meet and agree upon the completion status of the work in progress, and any major logic changes proposed by the Contractor.
3. Maintain the Construction Schedule at the project meeting location and update weekly by drawing a line vertically through the corresponding progress of each task on the schedule as of the date of that project meeting. The line shall be in varying colors so that differentiation between weeks is readily apparent.

B. Weekly Meetings:

1. Update the reviewed Construction Schedule at each weekly Project Meeting.
2. Indicate "actual" progress in percent complete for each activity.
3. At each project meeting discuss the Short Interval Schedule. Any deviation from the planned schedule shall be explained by Contractor, with corrective measures, if necessary, to bring progress of Work back in line with the Contract Completion date.

C. Monthly Update:

1. If substantial changes have occurred in the Construction Schedule, or if enough changes have occurred that the schedule is rendered inaccurate or ineffective, submit with the next application for payment a revised updated Construction Schedule showing the original baseline schedule and revised schedule on the same copy for evaluation and measurement of actual work-in-place.
2. If the contractor does not submit a revised schedule with a payment request, it is agreed by the Contractor that the project is still on schedule according to the last submitted schedule.
3. The Contractor shall maintain an ID system so that if the logic changes, or other tasks are inserted, the original task and any inserted task always maintain the originally assigned ID number.
4. Contractor shall submit an updated schedule at the monthly progress meeting following either one of the following two occurrences:
 - a. Upon completion of a major milestone; or,
 - b. When the actual work completed is more than two (2) weeks behind schedule. Should the schedule show the project completion to be more than two weeks behind, the Contractor shall submit a written explanation and recovery schedule outlining corrective action taken or proposed to bring events back on schedule within a 30 day period.
5. Show changes occurring since previous schedule submission, such as:
 - a. Any major changes in scope, including authorized Field Orders or ChangeOrders;

- b. Contractor reorganization of his work sequence unrelated to changes in scope;
 - c. Activities modified since previous submission;
 - d. Revised projections for progress and completion, as applicable; and
 - e. Any other identifiable changes.
 6. Provide narrative report as needed to define:
 - a. Problem areas, anticipated delay, and impact of these on schedule; and
 - b. Corrective action recommended and its effect.
- D. Subcontractor Participation:
 1. Involve all major subcontractors in preparation of the Periodic Updates of the Construction Schedule.
 2. Obtain approval of the schedule from each major subcontractor and submit in writing together with the Periodic Updates of the Construction Schedule.
- E. Change Orders:
 1. Authorized changes to the work shall be included in the schedule network as they occur in the same format and level of detail as contained in the current updated schedule. Enough activities shall be included to adequately describe the work. Code the activities in such a way that they can be identified to the specific Change Order. Insert the Change Order Activities in the network with appropriate logic ties to original network activities.
 2. Utilize the time impact analysis submitted with the change order to demonstrate the effect of delays on the overall project schedule.

3.05 TIME EXTENSIONS

- A. The Contractor shall notify the Owner and Architect in writing within seven (7) days of the event of any event which could delay performance or supplying of any item of the work affecting the critical path. Contractor shall indicate the expected duration of the delay, the anticipated effect of the delay on the Contractor's Construction Schedule, and the action being taken to correct the delay situation.
- B. Extensions of time to the Contractor's Contract may be granted only for delays to activities on the critical path that actually delay the Project Completion beyond the date of Substantial Completion, or for delays to activities that transform that activity onto the critical path, and as a result cause a final completion date beyond the contracted final completion date.
- C. Following receipt of an executed Change Order extending the Contract Time, the activity data and logic relationships shall be incorporated into the current detailed CPM schedule during the next scheduled progress update, as outlined above in Paragraph F "Change Orders" above. In the event the Contractor is entitled to a change in the Contract Time, the adjustment to the contract Time shall be as defined in the General Conditions.

END OF SECTION 01 32 16

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including the following:

- 1. Shop Drawings.
- 2. Product Data.
- 3. Samples.

The individual submittal requirements of certain submittals are specified in applicable sections for each unit of work.

- B. Refer to other Division 01 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:

- 1. Permits.
- 2. Applications for Payment.
- 3. List of subcontractors.

- C. Shop drawings, product data, samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate, for those portions of the Work for which submittals are required, how Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

1.03 DEFINITIONS

- A. Shop Drawings: Shop drawings include specially-prepared technical data for this project, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to several projects. Reproduction of Contract Document drawings are not considered to be shop drawings unless approved by the A/E.

- B. Product Data: Product data includes standard printed information on materials, products and systems, not specially-prepared for this project, other than the designation of selections from among available choices printed therein.

- C. Samples: Samples include both fabricated and unfabricated physical examples of materials, products, and units of work; both as complete units and as smaller portions of units of work; either for limited visual inspection or (where indicated) for more detailed testing and analysis.

- D. Field Samples: Field samples are full-size physical examples erected on-site to illustrate finishes, coatings, or finish materials. Field samples are used to establish the standard by which the Work will be judged.

- E. Mockups: Mockups are full-size assemblies for review of construction, coordination, testing, or operation; they are not Field Samples.
- F. Coordination Drawings: Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended.
 - 1. Preparation of Coordination Drawings is specified in Section 01 31 00 and may include components previously shown in detail on Shop Drawings or ProductData.

1.04 SUBMITTAL PROCEDURES

- A. Provide a submittal on every product and material used in the Project. Before submittal of shop drawings, brochures, and lists, Contractor shall carefully review same for proper identification, completeness, correctness, dimensions, and technical applicability to the Contract Document requirements and note all corrections, items needing clarification, additional comments, and the like. Upon thorough review and subsequent acceptance by the Contractor, if so accepted, Contractor is to note its approval together with said notes or amendments thereto for compliance with the Contract Documents by suitable stamp, date and the signature of the Contractor or its authorized representative. Submittals will be returned to the Contractor without action by the A/E if the items submitted are not stamped, signed, and identified as approved or approved as noted or other similar language indicating approval by the Contractor, or if the submittal is obviously not thoroughly reviewed.
- B. Submission of shop drawings and samples shall be accompanied by one original and one copy of a transmittal letter containing Project name, Contractor's name, number of drawings and samples, titles and other pertinent data.
- C. Many products are specified by one or more named products/manufacturers. In those circumstances where Contractor submits an unnamed, non-prior approved product/manufacture during this 'shop drawing' phase, said submittal shall be submitted in conformance with product substitution requirements of Section 01 61 00, Article 2.03.
- D. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - a. The Contractor shall provide submittals requiring coordination with other submittals to the A/E at one time. The A/E will review submittals as received, provide comments, and return them to the Contractor. If the Contractor did not submit all submittals requiring coordination at the same time, and a later submittal identifies conflicts, the Contractor will be responsible for all costs associated with changes necessary to properly coordinate the installation of the materials.
 - 3. To avoid the need to delay installation as a result of the time required to process submittals, the Contractor shall anticipate the review times noted in this section and anticipate the possibility of a resubmittal or rejected submittal and the effect that action would have on the Project schedule.
 - a. All required submittals shall be initially received by the A/E within 60 days following the Notice To Proceed date, or sooner as required by the following submittal review times, to meet the Construction Schedule need for materials related to the submittals. Submittals received after these time periods shall not be a cause for delay claims to the Project. A/E will not accelerate review time for submittals received after the indicated time periods, regardless of any potential impact to the Contractor's schedule.

- b. Submittals requiring color selection and material selection are interdependent on receiving all submittals at the same time that have such selection requirements. Allow 20 working days from the date of receipt of the last such submittal by the Contractor for the A/E to complete color selections and mail out from the A/E's office.
 - c. For all other submittals, allow 10 working days after receipt by the A/E to complete the initial review and mail out from the A/E's office.
 - d. If the A/E must delay processing a submittal to permit coordination with subsequent submittals, the 10 working days will begin upon receipt of the last such coordination submittal from the Contractor.
 - e. If several submittals are provided by the Contractor at the same time, allow 20 working days after receipt by the A/E to complete the initial review and mail out from the A/E's office. Provide an "Order of Priority List" to the A/E with the submittal.
 - f. If an intermediate submittal is necessary, process the same as the initial submittal.
 - g. Allow 10 working days for reprocessing each submittal after receipt.
- E. Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block. Consecutively number each submittal beginning with the number 001.
1. Provide adequate space for the Contractor's stamp and approval, plus a space approximately 4 by 5 inches each on the label or beside the title block on Shop Drawings to record the A/E's review and approval markings and the action taken.
 2. Include the following information on the label or title block for processing and recording action taken.
 - a. Project name and job number.
 - b. Date.
 - c. Name and address of the A/E.
 - d. Name and address of the Contractor, subcontractor, supplier and manufacturer as appropriate.
 - e. Number and title of appropriate Specification Section.
 - f. Drawing number and detail references, as appropriate.
- F. Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the A/E using a transmittal form. Submittals received from sources other than the Contractor will be returned through the Contractor without action.
1. Address no more than one topic or related topics on a single transmittal (i.e. mechanical items shall not be submitted under same transmittal with electrical items).
 2. Record relevant information, deviations, and requests for data, including minor variations and limitations from the Contract Documents.
 3. Shop drawings, product data, samples, and mock-up as required for submissions by the technical specification sections are to be submitted for A/E's review/approval. The number of submittals required is noted in the parenthesis.
 - a. Shop Drawings: (6) sets; provide one (1) additional set for Structural, Mechanical, Electrical and Elevator submittals
 - b. Product Data: (6) copies; provide one (1) additional copy for Structural, Mechanical, Electrical and Elevator submittals
 - c. Samples: (3) samples
 - d. Mock-ups: As required by any technical specification section.
 - e. Demonstrations: As required by any technical specification section.
 - f. Reference applicable mechanical and electrical technical specifications' sections for additional submittal requirements.
 4. Material and Color Submittal: Submit samples of actual colors of materials.
 5. Number submittals as follows: Numerical Order, Spec Section, Revision Letter.
 6. In the event of the need to "revise and resubmit" a submittal, resubmit same in acceptable form/content, clearly identifying deviations from previous submittal content.

1.05 SHOP DRAWINGS

- A. Submit drawings drawn to accurate scale. Do not reproduce Contract documents or copy standard information for use as Shop Drawings. Standard information prepared without specific references to the project is not a Shop Drawing.
- B. Include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings. Include the following information:
 - 1. Dimensions;
 - 2. Identification of products and materials included;
 - 3. Compliance with specified standards;
 - 4. Notation of coordination requirements;
 - 5. Notation of dimensions established by field measurements; and
 - 6. Any deviation from contract drawings or specifications;
 - 7. Date when review has to be finalized to meet schedule.
- C. Except for templates, patterns and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2" x 11", but no larger than 24" x 36".
- D. Shop drawings shall clearly indicate the correct configurations and relative sizes, materials, metal gauges, etc. of the various components and the proposed methods of fabrication, required clearances, supports and any other pertinent data.
- E. All items shown on shop drawings that do not conform to plans and specifications shall be specifically noted as such (flagged) and brought to the A/E's attention. In any case, the A/E's stamp of review shall not include approval of unauthorized changes in the Contract Documents, except where specific written approval is given.
- F. Contractor is responsible for obtaining and distributing required prints of shop drawings to its subcontractors and material suppliers after as well as before final review by the A/E. Prints of reviewed shop drawings shall be made from returned transparencies which carry the Contractor's and A/E's appropriate stamps. A/E / Owner and applicable consultants and governing agencies will retain copies of each shop drawing submittal. Reproducible transparency and all remaining prints not otherwise retained will be returned to Contractor.
- G. At A/E's discretion, the prints distributed by the A/E including the one print returned to the Contractor (in addition to the original transparency) may consist of copies made from the marked-up and stamped transparencies.

1.06 PRODUCT DATA

- A. Product data includes Material Safety Data Sheets (MSDS), manufacturer's printed installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves.
 - 1. Where product data must be specifically prepared because standard printed data is not suitable, submit as Shop Drawings.
- B. Mark each copy to show applicable choices and options, and indicate the applicable information on selected products. Include the following information:
 - 1. Manufacturer's printed recommendations.
 - 2. Compliance with recognized trade association standards;
 - 3. Compliance with recognized testing agency standards;
 - 4. Application of testing agency labels and seals;
 - 5. Notation of dimensions verified by field measurement;
 - 6. Notation of coordination requirements; and

7. Any deviation from Contract Drawings or Specifications;
 8. Date when review has to be finalized to meet schedule.
- C. The Contractor is responsible for providing certification that all construction materials used on the Project are 100% free of asbestos and lead.

1.07 SAMPLES AND MOCK-UPS

- A. Submit samples and mock-ups that are identical with the material or product proposed. Samples include partial sections of components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.
1. Package samples to facilitate review. Prepare samples to match the A/E's sample. Include the following:
 - a. Generic description of the sample;
 - b. Sample source;
 - c. Product name or name of manufacturer;
 - d. Compliance with recognized standards;
 - e. Availability and delivery time; and
 - f. Specification section.
- B. Submit samples and mock-ups for review of kind, color, pattern, and texture, for a comparison of these characteristics before the actual component installation and after final submittal.
1. Where variation in color, pattern, texture or other characteristics are inherent in the material, submit not less than four (4) units to show approximate limits of the variations.
- C. Where samples are for selection of appearance characteristics from a range of standard choices, submit a full set of choices for the material or products.
- D. Maintain sets of approved samples and mock-ups, at the project site, for quality comparisons throughout the course of construction.
- E. Demolish and remove all samples and mock-ups, at the project site, for quality comparisons throughout the course of construction.

1.08 A/E's ACTION

- A. Except for submittals for record, information or similar purposes, A/E will review each submittal, mark to indicate action taken, and return promptly.
- B. A/E review of submittals does not release Contractor from a proper installation, compliance with applicable codes, or coordination of the Work.
- C. The A/E will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be marked to indicate the action taken.
- D. The following is a copy of the A/E's review stamp:

ARCHITECT'S REVIEW		RESPONSE REQUIRED OF CONTRACTOR
<input type="checkbox"/> No Exceptions Taken	<input type="checkbox"/> Rejected	<input type="checkbox"/> Confirm and Verify
<input type="checkbox"/> Note Markings	<input type="checkbox"/> Comments Attached	<input type="checkbox"/> Resubmit

Architect's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, for coordination of his work with that of other trades, and for performing his work in a safe manner.

By: _____ Date: _____

- E. The A/E will distribute, as a minimum, the reviewed submittals as follows:
- (1) copy to A/E file; along with (1) sample
 - (1) copy to A/E subconsultants. For those submittals requiring review by A/E subconsultant (i.e. Structural, Mechanical, Electrical, Elevator, etc.)
 - (1) copy to PM; along with (1) sample
- Remainder of copies submitted by the Contractor

END OF SECTION 01 33 00

SECTION 01 35 20
SAFETY PROCEDURES

PART 1 - GENERAL

1.01 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.

1.02 PRELIMINARY WORK

- A. Prior to the start of and during the course of above and below ground Work the Contractor shall make a thorough survey of the entire worksite to determine all potential hazards and notify the Owner in writing of any such hazards prior to the commencement of work. Workmen shall be made aware of those hazards and shall be instructed in procedures and the use of equipment for their protection. The Contractor shall verify the location, condition, and whether it is active or inactive of all utilities on and near the worksite and take precautions to protect all people working on the project, the general public, and the property.
- B. Submit a site specific safety plan in accordance with Supplemental Conditions section 5.07. Submit to allow review and re-submittal with modifications prior to beginning any work.

1.03 IMMINENT DANGER

- A. The Contractor shall be wholly responsible for all accidents or death occurring at any time during the progress or completion of this project which may happen to any person employed to perform work on this project; or for any injury or death its work, operations, or persons performing work on this project may cause to any person not employed in the work of this project; or for any damage its work, operations, or persons performing work on this project may cause to the work being constructed, or to any existing public or private property, either on or adjoining the project site or along any routes of travel. Completion of this project includes any time work is being performed on this project, even after final acceptance by the Owner.

1.04 SAFETY

- A. The Contractor shall ensure that all persons, while on the work site, comply with the requirements of WISHA, these requirements, and the safety precautions contained in the several Specification Sections. The Contractor shall promptly and fully comply with, execute and, without separate charge thereof to the Owner, shall enforce compliance with the provisions of the latest adopted Washington Industrial Safety and Health Act, with particular attention paid but not limited to Chapter 296-155, WAC Safety Standards for Construction Work; with particular attention paid but not limited to Chapter 296-24 WAC General Safety and Health Standards; with particular attention paid but not limited to Chapters 296-27, 196-350 and 296-360 WAC regarding Administrative Safety and Health Act Chapter 49-17 RCW, and any addenda thereto.
- B. The Contractor shall immediately advise the Owner of inspections conducted by WISHA at the work site, and shall transmit copies of reports, citations and violations to the Owner and A/E.

C. Entry Into Permit-Required Confined Spaces:

1. Entry into confined spaces such as steam tunnels, storm sewers, and as otherwise defined in Section 296-809-20002 of Chapter 296-809 WAC, Confined Spaces, shall be performed in conformance with permit entry procedures set forth in Section 296-809-500.
2. Employee training for employees entering a confined space shall conform to WAC Section 296-809-400.
3. It is recommend that when entry into a confined space is anticipated, a sub-consultant such as Pipe Experts LLC (360-943-5840) be contacted.

1.05 SAFETY RESPONSIBILITIES

A. Contractor shall be responsible to:

1. Ensure compliance with these requirements, WISHA requirements, and other safety requirements.
2. Authorize immediate action to correct substandard safety conditions.
3. Review and act to ensure compliance with safety procedures with its supervisors, subcontractors, and suppliers.
4. Make thorough daily safety inspections of the work site and immediately act to eliminate unsafe acts and unsafe conditions.
5. Investigate worksite accidents and recommend immediate corrective action.
6. Assist in the preparation of accident investigation and reporting procedures.
7. Be responsible for the control, availability, and use of safety equipment, including employee personal protective equipment.
8. Submit two (2) copies of site specific safety plan to Owner.

1.06 REQUEST FOR VARIANCES

- A. Requests for variances to deviate from WISHA requirements must follow the current established procedures by that Agency.

1.07 FAILURE TO COMPLY

- A. If work on the project is stopped due to the Contractor's failure to comply with the requirements of WISHA or other applicable safety requirements, no part of the time loss due to any such suspension of operations or stop orders shall be made the subject of a claim for extension of time or for increased cost or damage by the Contractor.

END OF SECTION 01 35 20

SECTION 01 41 00
REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Under General Conditions for Washington State Facility Construction, Article 5.02 C., the Contractor is to comply and give notices required by various authorities having jurisdiction. Except where otherwise expressly required by applicable Laws and Regulations, neither the Owner or A/E shall be responsible for monitoring the Contractor's compliance with those requirements. The Contractor is responsible for keeping building department, fire department, and other authorities completely informed of any changes in the work in a timely manner. This includes contract modifications, amendments, additions, shop drawings, and the like, current as of the Contract Document date.
- B. The Contractor is responsible for gaining approval as required for Owner occupancy within contract schedule requirements.
- C. Make any and all adjustments or modifications as required to conform to ordinances, and regulations.

1.02 COMPLIANCE REQUIREMENTS

- A. Referenced codes establish minimum requirement levels. Where provisions of various codes or standards conflict, the more stringent provisions govern. Promptly submit to A/E written notice of observed contract document variations from legal requirements.
- B. Compliance requirements include, but are not limited to the following:
 - 1. International Building Code, Washington State Amendments, as adopted by the Authorities Having Jurisdiction (AHJ); Barrier-Free Code Washington Administrative Code (WAC) 51-50; ANSI 117.1; ADA Accessibility Guidelines (ADAAG), whichever is most stringent.
 - 2. The Life Safety Code NFPA 101.
 - 3. Fire Doors/Windows, NFPA 80.
 - 4. Rules and Regulations for the State Board of Health.
 - 5. Department of Labor and Industries Regulations.
 - a. In particular, note requirements of the Hazard Communication Standard, WAC 296-62-054 through -05427.
 - 6. Department of Ecology Regulations.
 - a. In particular, note requirements of Emission Standards - Volatile Organic Compounds, WAC 173-490.
 - 7. Mechanical, Plumbing & Fire Suppression Work:
 - a. International Mechanical Code.
 - b. International Plumbing Code.
 - c. National Fire Protection Association Codes.
 - d. International Fire Code.
 - 8. Electrical Work:

- a. Underwriters' Laboratories (UL).
 - b. National Manufacturers' Association.
 - c. National Fire protection Association, National Electric Code (NEC), National Electric Safety Code.
9. Environmental Requirements: All work to be performed in compliance with applicable provisions of chapters 43.21C RCW and 90.50 RCW as amended, 70.105 RCW, Hazardous Waste Management Act of 1976, and other applicable federal, state, and local statues, ordinances and regulations dealing with prevention of environmental pollution and the preservation of public natural resources that affect or are affected by this project, as well as applicable provisions of Title 39 RCW and Chapter 60.28 RCW are referred to the attention of the Contractor and are incorporated herein.
 10. Factory Mutual (FM).
 11. Industrial Risk Insurers (IRI).
 12. Energy Requirements:
 - a. Comply with insulation and energy conservation requirements of State of Washington.
 13. Remediation Requirements: Reference technical specifications for additional regulations concerning abatement and remediation of hazardous materials.
 14. Occupational Safety and Health Administration (OSHA)
 15. Washington Industrial Safety and Health Act (WISHA)
 16. AHJ Codes, Standards & Ordinances.
- C. Drawings and Specifications govern whenever Drawings and Specifications require higher standards than are required by governing codes, regulations, and the like.

1.03 SUBMITTALS

- A. For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established in conjunction with compliance with standards and regulations bearing upon performance of the Work prior to Final Completion.

END OF SECTION 01 41 00

SECTION 01 42 00

REFERENCES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. See other sections of the specifications for additional definitions.

1.02 DEFINITIONS

- A. General: Basic contract definitions are included in the General Conditions for Washington State Facility Construction. The following supplements Part 1 of those Conditions and expands on definitions and intent of language generally used in the Contract Documents.
- B. "Accepted": Means accepted by the A/E when used in conjunction with the A/E's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Approved": Where used in conjunction with A/E's response to submittals, requests, applications, inquires, reports, and claims by Contractor, the meaning of the term "approved" will be held to limitations of A/E's responsibilities and duties as specified in General and Supplementary Conditions. Where the terms "or approved" or "as approved" or "for approval" are used, the A/E is the sole judge of the quality and suitability of the proposed substitutions. In no case will "approval" by A/E be interpreted as a release of Contractor from responsibilities to fulfill requirements of the Contract Documents. Whenever a material, article or piece of equipment is identified on the Drawings or in the Project Manual by reference to manufacturer's or vendor's names, trade names, catalog numbers, or the like, and followed by the wording "or approved", "or approved substitute" or "equivalent, as approved", it is so identified for the purpose of establishing a standard, and any material, article, or piece of equipment of other manufacturers or vendors which will perform adequately the duties imposed by the general design will be considered equally acceptable provided the material, article, or piece of equipment so proposed is, in the opinion of the A/E, of equivalent substance, quality, appearance or function and has been approved by the A/E in writing prior to bid opening in conformance with the provision of Section 01 61 00, Common Product Requirements, Article 2.03. It shall not be purchased or installed by the Contractor without A/E's and Owner's prior written approval.
- D. "A/E", "Consultant": Means the design firm identified in the Contract Documents.
- E. "As required": Means as required to suitably complete the work and at the direction of the A/E.
- F. "Authority Having Jurisdiction" (AHJ): Means any person which has responsibility related to issuing final occupancy and permits for this Project.
- G "Concealed": Means spaces out of sight. Such as above ceilings, below floors, between double walls, furred-in areas, pipe and duct shafts, and similar spaces.
- H. "Conditions" or "General Conditions": Means General Conditions for Washington State Facility Construction.

- I. "Coordinate": Means the Contractor is to coordinate scheduling, submittals, and work of various sections of the specifications, drawings and construction of all trades to assure efficient and orderly sequence of interdependent construction elements for a complete and operating installation.
- J. "Demolish": Means to tear down and remove completely, including any anchors, unless noted otherwise, without damaging adjacent surfaces that all to remain.
- K. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the A/E, requested by the A/E, and similar phrases. However, no such implied meaning will be interpreted to extend A/E's responsibility into Contractor's area of construction supervision.
- L. "Engineer": Where the term engineer is used, it means either:
 - 1. Consultant in its respective discipline to the A/E or Owner as listed in the Project Manual.
 - 2. Consultant to the Contractor, retained by contractor to perform services required by construction activities.
- M. "Experienced": When used with respect to any trade performing services for the project, means having a minimum of 5 successfully completed previous projects similar in size and scope to this project, being familiar with the special requirements indicated, and aware of and compliance with AHJ requirements.
- N. "Exposed": Means open to view and not covered or concealed.
- O. "First Class Workmanship": Means to
 - 1. Verify before installing any material that the receiving surface is plumb, level, true to line, and straight to achieve tolerances identified. Surfaces not meeting this criteria are to be identified to the contractor and corrected before proceeding.
 - 2. New work is to be tight, straight, even, and smooth with respect to the new work and interfacing with adjoining surfaces.
- P. "Furnish": Means to supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.
- Q. "General" or "General Requirements": The provisions or requirements of Division 1 Sections. General Requirements apply to entire work of Contract and where so indicated, to other elements of work which are included in the Project.
- R. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, or other paragraphs or Schedules in the Project Manual (Specifications and Detail Book), 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, and is applicable where reasonably implied and necessary in conformance with work specified, drawn, or required for completion.
- S. "Inspection": As used in reference to actions of the A/E or his/her consultants, shall mean to review or observe the Work, but not to "inspect" the Work as the Contractor or Authority Having Jurisdiction will inspect.
- T. "Install": Means operations at the Project Site including the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations to permanently affix to project, as applicable in each case.
- U. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.

- V. "Install in Accordance with Manufacturer's Instructions and Directions": Throughout the Documents, although it may not be specifically stated, the Contractor is to install all work in accordance with Manufacturer's literature, unless otherwise noted or directed, for the best results. Where more than one Manufacturer is involved in the work, or its component parts, the Contractor shall follow each Manufacturer's literature.
1. In the event of conflict between the Manufacturer's literature, or its literature and the Contract Documents, the Contractor shall submit the discrepancy or conflict to the A/E for resolution and written instruction prior to proceeding with any work.
 2. No Manufacturer preparatory steps or installation procedures may be omitted. If the Contract Documents generalize the installation procedure, but do not necessarily mention all procedures, those procedures are not exempt from being completed by the Contractor unless they are specifically modified or stated as being exempt.
- W. "Owner": Means the "State of Washington, Department of Enterprise Services, acting through the Division of Engineering and Architectural Services (E&AS)".
1. E&AS will be represented by a Project Manager (PM) who has been involved with the design and is responsible for managing the A/E Agreement and Construction Contract.
 2. E&AS may assign a project specific Site Representative to be present on-site during construction. This "Site Rep" will observe and report daily activities to the Owner and provide assistance to assure Owner impacts, project access, construction quality and construction related responses are addressed. As an agent of the Owner, the Site Rep may expedite Owner decisions.
 - a. The Site Representative will make daily visits to the site to review the progress of the work and its conformance with the Contract Documents. The Site Representative will bring relevant issues to the attention of the Contractor's QA Representative, A./E, and PM. The Site Representative will coordinate with other General Administration staff on Owner related issues.
 - b. The Site Representative will participate in the pre-construction meeting, quality control meetings, progress meetings, pre-installation meetings, and closeout/punch list meetings in addition to walk-throughs.
- X. "Patch": Means to cut out to nearest joint and replace with like kind material.
- Y. "Product": Means materials, systems and equipment provided by the Contractor for use in the Work.
- Z. "Project Manual": Means the volume(s) included as part of the Project Documents.
- AA. "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.
- AB. "Provide": Means to furnish, coordinate, and install, complete, in place and ready for the intended use.
- AC. "Regulations": Means 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.
- AD. "Remove": Means to detach items from the existing construction and legally dispose of off-site unless indicated to be "removed and salvaged" or "removed and reinstalled".
- AE. "Repair": Means to perform minor corrections and patching of all indicated materials.

- AF. "Replace": Means to provide new material to match adjacent materials, unless noted otherwise.
- AG. "As Required": Means to complete the work in a first class workmanship manner.
- AH. "Remove and Salvage": Means to remove, clean, and pack or crate item to protect against damage, identify contents of packed item, and deliver to Owner's designated storage area.
- AI. "Remove and Reinstall": Means to remove, clean, service, and otherwise prepare the item to be reused; restore if the item is historic; store and protect against damage and reinstall in the same location or as otherwise indicated.
- AJ. "Satisfactory": Means "satisfactory to the A/E and Owner"; the A/E shall be the sole judge of the acceptability of a product or an installation.
- AK. "Selected": Means "selected by the A/E and Owner" and is not necessarily limited to a manufacturer's standard line of colors, finishes or details.
- AL "Similar", "Similar to": Where the words "similar" or "similar to" are used:
1. Where it occurs in the Contract Documents, shall mean that a portion of the Work shall have common features and be visually consistent with, but may not necessarily be identify to, related portions of the Work. Contractor shall correlate similar conditions of the Work. The Contractor shall identify any uncertainties to the A/E. Do not proceed without A/E's direction.
 2. Where it is followed by a manufacturer's name and product, model, or type number, such manufacturer, product, model or type number shall be considered as the standard of quality for the item or product work specified, in a general and technical sense, not meaning "identical", and the provisions pertaining to "or approved" shall apply to any other proposed material, article, or piece of equipment of other manufacturers or vendors.
- AM. "Testing Agencies": Means 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.
- AN. "Trades": Means any person or group of people which provides services to or work on the Project. Using terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
- AO. "Verify": Means the Contractor is to verify existing conditions and coordinate any variations from what is shown in the Contract Documents with the A/E.

1.03 SPECIFICATION AND DRAWING FORMAT AND CONTENT EXPLANATION

- A. The General Conditions, Supplemental Conditions, and Division 01 of these specifications shall be a part of technical Divisions and Sections the same as if they were specifically called for in each section.
- B. Wording of these Specifications: These Specifications are of the abbreviated or streamlined type and may include incomplete sentences. Words such as "shall," "the Contractor shall," "shall be," and similar mandatory phrases, are included by inference.
- C. Tense, Gender, Singular, Plural: Present tense words include future tense. Words in masculine gender include feminine and neuter genders. Words in the singular include plural. Plural words include singular.
- D. All, Entire, and the Like: For brevity throughout the documents, these words may be omitted.

Read their implications into all work, as the following parenthetical insertion exemplifies:
“Balance and adjust (all) dampers.”

- E. Specification by Reference: Any material specified by reference or number, symbol or title of a specified standard, such as commercial standard, ANSI and ASTM documents, Federal Specifications, trade association standard, or the like, shall comply with the following:
 - 1. The latest revision requirements thereof;
 - 2. Any amendment or supplement thereto in effect on date of the Project Manual, except as modified;
 - 3. When building code requirements refer to a different issue of standards specifications, such issue governs.
- F. Drawings are in part diagrammatic and do not necessarily show complete details of construction, work or materials, performance or installation. They do not necessarily show how construction details, other items or work, fixtures, and equipment may affect any particular installation. The Contractor is required to ascertain and correlate the work to bring the parts together into a satisfactory and completed whole.
 - 1. Where on any of the drawings a portion of the work is drawn out and the remainder is indicated in outline, the parts drawn out shall apply also to all other portions of the work.
 - 2. Wherever a detail is referenced and developed for a specific condition, same or similar detail shall apply to identical or similar conditions elsewhere on project even though not specifically referenced.

1.04 INDUSTRY STANDARDS

- A. Except where 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. Comply with the standards in effect as of the date of the Contract Documents.
- C. Where compliance with 2 or more standards is specified and the standards established differ or have conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer to the A/E before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum acceptable. 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 the requirements. Refer uncertainties to the A/E for a decision before proceeding.
- D. Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Contractor shall obtain copies directly from the publication source and have them available at the job site all reference standards which are referenced in the technical specifications of the Project Manual or on the Drawings.
- E. Graphic Standards: Symbols used in the Contract Documents, except as otherwise noted, are those symbols recognized in the construction industry for purposes indicated.

END OF SECTION 01 42 00

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SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

- A. This Section includes requirements for construction facilities and temporary controls, including temporary utilities, support facilities, security and protection. Nothing in this section is intended to limit types and amounts of temporary work required, and no omission from this Section will be recognized as an indication that such temporary activity is not required for successful completion of the work and compliance with the requirements of the Contract Documents.
- B. Unless otherwise noted, the temporary utilities described herein shall be provided by the Contractor. Work and requirements include, but are not necessarily limited to, the following:
 - 1. Provide temporary devices, equipment, power and other utilities as needed for use, convenience and safety of personnel engaged in the work of the Contract. Installations of temporary utilities is to be safe, non-hazardous and sanitary; they are to be protective of persons and property, and be free of deleterious effects.
 - 2. Locate temporary utilities where required or as directed or approved by Owner and A/E.
 - 3. Make all service connections to existing services in approved manner, in accordance with code requirements, and with prior approval of Owner.
 - 4. Install extensions and branches, as required.
 - 5. Maintain and protect temporary utilities.
 - 6. Remove from site upon completion of the Project or when directed.

1.03 QUALITY ASSURANCE

- A. Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
 - 1. Building code requirements: Local and state.
 - 2. Health and safety regulations.
 - 3. Utility company regulations.
 - 4. Police, fire department, and rescue squad rules.
 - 5. Environmental protection regulations.
- B. Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

1.04 WORKING HOURS

- A. Refer to SUMMARY OF WORK Paragraph 1.06 Working Hours and Paragraph 1.09 Contractors Use of Premises, for a description of the Contractors normal working hours.

1.05 SPECIAL CONDITIONS

- A. The Contractor is responsible for providing and maintaining controls using methods, equipment and temporary construction as necessary to protect against unfavorable conditions during the construction of the project. Following are requirements related to restrictions and other physical conditions that will affect the Contractor's methods of work.
1. Varying types of temporary dust barriers shall be required to isolate construction areas from non-construction areas and provide for sound attenuation.
 2. Availability of on-site storage is minimal. Contractor shall account for bringing materials in and disposing of materials on a regular basis.
 3. Construction access is limited, both for location and height restrictions.
 4. The Contractor shall provide exhausting for any vehicles or equipment which will be in a space where exhaust fumes can accumulate. Exhaust ducting must be routed to open air space in a manner acceptable to the Owner which will not restrict normal daily activities. The Contractor shall provide temporary exhausting, or other proven method of controlling other odor causing activities, such as, but not limited to, welding or demolition.
 5. The use of jackhammers or other similar equipment that causes excessive vibration is not permitted, unless an exception is requested by the Contractor and approved by the Owner.
 6. Demolition shall occur in a controlled manner to avoid excessive dust, noise and vibration generation.
 7. Avoid use of tools and equipment that leak or leave waste material behind. In cases where minor leakage is unavoidable (generators, compressors, etc.), drip pans shall be provided.
 8. Contractor shall be required to give the Owner ample notice to relocate tenants that will be in the path of construction activity. Responsibility for relocating tenants within the limits of construction will be the Owner's.

1.06 EXISTING WORK

- A. Existing construction and equipment not scheduled to be removed shall be kept in its original condition. If damaged, replace at no additional cost to the Owner.
- B. Repair damaged surfaces to match adjacent finish.

1.07 PROTECTION OF EXISTING UTILITIES

- A. Known utilities of record are shown on the Contract Drawings but are not to be considered as As-Built. The Contractor shall consider that the actual As-Built location may be within a tolerance of five (5) feet vertically or five (5) feet either side horizontally of that indicated in the documents. The Contractor shall take the following steps:
1. Notify Owner in writing, on each occasion, of the intent to work near existing utility services or structures or when a new excavation or saw cutting operation is about to begin. Submit procedure for approval to assure safe and continuous operation of the services.
 2. Proceed with sufficient caution within the As-Built tolerance area to preclude damaging any known utilities. In the event unidentified utilities are encountered, notify Owner's Representative immediately.
 3. In the event unknown utilities are damaged during construction, temporary services and/or repairs shall be made immediately by the Contractor to maintain continuity of services. Costs for temporary and/or permanent repairs will be accounted for through a Change Order.

1.08 CONSTRUCTION OPERATIONS IN OR AROUND A PUBLIC BUILDING

- A. College facilities typically are open to the public Monday through Friday from 6:00 a.m. to 9:00 p.m., with some areas operational twenty-four (24) hours a day. Employees including those with disabilities have access to the building twenty-four (24) hours a day. Consideration and concern for the safety of workers and the public shall be in the Contractor's mind at all times.
- B. Contractor shall recognize that the public as well as the employees can be expected to be on the project site during the course of the project. Certain areas within the limits of construction may be vacated by the Owner prior to the NTP. When vacated, these areas will be available for Contractor use throughout the duration of the project. Access through these areas by the Owner shall be provided where indicated, both during and outside the Contractor's normal working hours. Disturbance of building occupants shall be kept to an absolute minimum. Regular and emergency egress and accessible routes of travel shall be maintained at all times and shall be kept free of construction materials and debris. Any periods of interruption shall be coordinated with the Owner and shall not commence without the Owner's prior written approval. In general, notification must be given seven (7) days in advance and be indicated on the CPM schedule.
- C. Contractor shall be limited to staging areas and routes into and out of the project area as designated in the Contract Documents and which do not block accessible entrances or accessible parking. Storage of construction debris and stockpiled materials shall only be permitted in those areas indicated and within the construction area in a manner that does not obstruct or cause potential harm to anyone using identified paths through the construction area. Care must be taken that no hazardous or dangerous materials or debris be left in accessible areas. All construction materials shall be stored in secured areas.
- D. A portion of the work may require the Contractor to work outside the identified limits of construction. Contractor shall be required to coordinate all such work with the Owner and notify the Owner a minimum of (2) weeks in advance. Such notification shall include an identification of the area which the Contractor will require to perform the work, a description of the work to be performed, and a duration (in calendar days) until the work is completed.
 1. Work in these areas will affect the Owner's normal operations and require coordination. The Owner will be responsible for temporarily relocating people. The Contractor shall be responsible for the protection of any equipment or furniture in these locations during construction.
- E. At all times during the project the Contractor shall provide a safe, non-hazardous pathway for the designated primary and temporary emergency egress routes. The pathway shall be a minimum 4 feet wide and clearly marked at 10-foot intervals by directional painted arrows, cones and tape, or other commonly recognized and identifiable means. The pathway shall be a non-slip surface, either modifying the existing surfaces as necessary or providing a slip resistant plywood surface. Any exterior pathways shall be maintained so water does not pond on the route and no trip hazards exist.
- F. Security.
 1. Maintenance of Security:
 - a. It is the Contractor's responsibility to provide adequate security to protect the work site from unauthorized entry. Contractor shall be solely responsible for any theft, damage, or injury caused by a breach of such security.
 - b. Initiate security program promptly after job mobilization, when temporary enclosures are installed.
 - c. Maintain security program throughout construction period, until Owner occupancy or Owner acceptance precludes the need for Contractor security.
 2. Entrance Control:

- a. Provide control of all persons entering and leaving work area.
- b. Allow entrance only to authorized persons with proper identification.
- c. Owner's access to construction site shall be allowed at all times.

G. Emergency Procedures.

1. For emergencies requiring ambulance, fire department or police assistance, dial 9-1-1 from regular phones or verify the process for Owner system phones. This phone number shall be posted at all Contractor phones.
2. Should the Contractor find it necessary to call for police assistance or protection in the exercise of its responsibilities, or in the event of other emergencies, call 9-1-1 first, then contact Owner. The contact number and name will be provided at the Preconstruction Meeting

H. Fire Safety.

1. Conduct operations in a manner that is fire-safe for the work area and adjacent areas. Maintain the premise clear of rubbish, debris, or other materials constituting a potential fire hazard. Maintain a proper fire separation between work area and any adjacent occupied areas. The local fire codes are incorporated herein by reference; adhere to all applicable provisions as determined by the local fire department. Contractor shall notify the Fire Department at commencement of construction.
2. Obtain permits as necessary, including but not limited to:
 - a. Cutting, Welding, Soldering, or any other type of open flame. Confirm with the local Fire Department if a Burn Permit is required on any open flame work, including soldering.
 - b. Storage of flammable materials (propane, butane, etc.) and/or compressed gasses.
3. Where significant or continued non-compliance with fire safety is noted, Owner reserves the right to stop the work at no extra cost or extension of time, pending remedial action. Reimburse Owner as appropriate, for any fines or penalties levied by the local fire department.
4. Report all construction fires and/or hazardous spills immediately by calling 9-1-1 and notifying the Owner Representative.
5. Contractor shall maintain all hallways, corridors, and/or adjacent egress areas free of construction materials, equipment, and rubbish at all times. Do not impair floor to floor fire separation. Submit an RFI for any clarifications needed regarding existing fire separations.
6. Provide temporary portable fire extinguishers for project as required by code. Permanently assigned fire extinguishers located in buildings do not alleviate Contractor's responsibility to provide standby extinguishers for project and "Fire Watch" needs.
 - a. A "Fire Watch" is to continue at least 30 minutes after "Hot Work" or cutting, welding or soldering procedures have stopped. A "Fire Watch" shall include monitoring of floors directly above and below "Hot Work" areas. "Hot Work" denotes any open flame procedure for the heating of materials during application processes.
 - b. Provide combustible and finished surfaces, equipment, electric cables, and personnel with protection to prevent damage or injury from molten metal, falling sparks, and welding arcs. Whenever practical, perform cutting and welding operations off-site.
7. Provide and install temporary exit signs to mark pathway, as needed, to insure a clear direction for emergency exit travel in occupied areas adjacent to the construction project. Review the temporary exiting routes and signage with Owner's Representative prior to making the changes.

I. Fire Protection Systems

1. Building and/or parking areas are either partially or fully protected with different types of fire suppression and smoke or ionization detection systems.

2. The Contractor shall cover existing fire detection devices. As a minimum, the cover is to be within the Project area and closely adjoining spaces to protect the detection devices from dust, debris, and potential false alarms.
3. The Owner and AHJ shall be notified seven (7) days in advance of work involving the disconnection or impairment of the fire alarm or protection systems.
4. If the Contractor causes a false alarm by failing to properly submit an Outage Request, submitting an inaccurate Outage Request, or accidentally discharges any protection system where the Fire Department responds, a unilateral deductive Change Order for \$500.00 will be written against the Contract to cover charges to the Owner from the Fire Department, and Owner costs for responding to the alarm.
5. The Contractor is to be fully familiar with and aware of all equipment that is being used on the project and the effect it could have on the systems.

J. Service Outages

1. Continuity of equipment and utility services to Owner property around the Project shall be maintained at all times. Equipment or utility shutdowns required to facilitate construction work shall be accomplished in accordance with the following requirements:
 - a. Service outages and interruptions shall be indicated on the overall construction schedule as well as the interval schedule.
 - b. Confirm all requests for equipment and utility outages in writing to the Owner on the Owner's Outage Request Form not less than four (4) working days prior to the proposed outage date. Any changes made to the original outage will require the outage be cancelled and a new outage form be filled out and submitted. The 4 day notification period will start over again with the newly prepared outage form.
2. Service outages to existing equipment and utilities shall be kept to an absolute minimum. Any outages required in the course of construction, whether for temporary services, cutovers, or testing shall be closely coordinated with the Owner and A/E. All service outages and electrical tie-ins will be required to be made between 6:00 p.m. Sunday and 4:00 a.m. Monday, unless otherwise indicated. The Contractor is responsible to reimburse the Owner for back charges of missed outages or re-connect stand-by time of Owner staff.
3. Do not proceed with any work requiring a service outage until confirmation is received from the Owner. Unless otherwise specifically indicated, written permission from the Owner takes a minimum of two (2) working days and a maximum of seven (7) working days from the time of request by the Contractor. Failure of the Contractor to submit outage requests which allow adequate time for Owner review and action shall not be grounds for requesting additional time or compensation.
4. Materials & equipment required for the work to be accomplished during an outage shall be complete and available on the job for review by the Owner at the time of the outage request. If the Contractor is not adequately prepared, the shutdown request will not be granted and must be rescheduled.
5. Only Owner's personnel will shut down and restart equipment and utilities. Owner will inspect the installation prior to restarting and will not restart if an unsafe condition exists. In the event Contractor's work is not completed during the time scheduled for the shutdown, Owner may elect to restart the equipment or utility services. In that event, additional outage requirements shall be rescheduled in accordance with the preceding requirements. Restarting shall not be construed as acceptance of the work as complete.
 - a. Owner's personnel required to complete utility outages, restarts and inspections will not typically be working during the Contractor's normal working hours as defined in Section 01 11 00. Contractor shall incorporate any affect that this may have on the progress of the project as part of the Base Bid. No overtime payments will be authorized for contractor or subcontractors to coordinate such work with Owner's personnel outside of Contractor's normal working hours nor will time delays be recognized due to the unavailability of these parties to complete these tasks during Contractor's normal working hours.

6. Include in the bid all costs associated with equipment and utility outages. Owner will make no extra payment for overtime work, schedule changes or failure to complete utility connections within authorized shutdown periods.

K. Material Storage

1. Confine storage to the designated areas. Maintain the storage areas in a clean and orderly manner.
2. Contractor shall be responsible for making provisions for any additional storage areas needed that cannot be accommodated within the limits of construction.

1.09 SPECIAL REQUIREMENTS

- A. Coordination: In addition to the requirements stated elsewhere in these specifications, Contractor shall coordinate the following with the Owner:
 1. All room, system or condition surveys requiring access to spaces other than public corridors or garage spaces shall be identified at least three (3) working days in advance of their occurrence for Owner's review.
 2. Pedestrian access and emergency egress routes shall be maintained throughout the Contract duration. Locations of these routes and relocation of these routes for construction purposes shall be identified at least three (3) working days prior to their being physically established. The conditions proposed for the access routes shall be clearly detailed by the Contractor for Owner's review.

PART 2 – PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Use qualified personnel for installation of temporary work. Locate temporary installations where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify as required.
- B. Provide each temporary installation ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until they are no longer needed or are replaced by authorized use of completed permanent installations.

3.02 TEMPORARY UTILITIES

- A. If the Contractor decides to use any of the equipment or materials installed under this contract for heating, power, lighting, or any other project need while the Project is still under construction, warranty on those materials shall not begin until Substantial Completion.
- B. Temporary Electric Power. The Contractor may use existing Owner power, if it is appropriate. The Contractor is to determine, with the Owner, the source and voltage prior to making any connections. The Contractor is to confirm the source of power with the Owner prior to making any connections. When the work is to be performed, the Owner is to be notified so they may observe any modifications being made. If existing power is inadequate for any reason, the Contractor is to provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.

1. If the Contractor provides its own distribution system, overhead wiring shall be installed where least exposed to damage and the vertical clearance is adequate for any Owner related service or delivery vehicles.
 2. No arc welders of heavy usage equipment are to be connected to the Owners system. The Contractor shall provide separate gas generators for this purpose.
- C. Temporary Lighting. The Contractor may use existing Owner lighting. Where lighting is inadequate, supplement as follows:
1. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.
 2. Provide a minimum of 5 foot-candles, higher if required by codes or regulations, of illumination in all building work areas where construction work is being accomplished; increase illumination to a minimum of 50 foot-candles for painting and other interior fine finish work. Provide additional illumination as directed for proper installation and inspection of interior finish work. Permanent lighting equipment may be used after it is installed provided that any damaged components are replaced, and that all components are cleaned prior to acceptance of the project.
 3. Provide temporary lighting as required for Owner use during non-construction times where construction has caused existing lighting to be temporarily out-of-service or blocked by construction staging materials. Temporary lighting must provide illumination levels equal to pre-construction conditions.
 4. Remove temporary lighting and power equipment and accessories and their connections at completion of the work or sooner if approved or directed.
- D. Temporary Heat. The Contractor may use existing Owner heating systems subject to compliance with provisions specified below. Where existing systems are inadequate, provide temporary heat required by construction activities for curing or drying of completed installations or for protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on workmen, completed installations, or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
1. No "salamander" type heaters are permitted in occupied facilities, or where the use is detrimental to finishes.
 2. The existing heating system may be used in lieu of the temporary equipment in conformance with the following requirements:
 - a. The responsibility for the heating system and its full operation is to be coordinated by the Contractor with the Owner until final acceptance of the building.
 - b. Provide air filters on any building fan equipment used for temporary heat.
 - c. Ensure that procedures, engineering controls, and other appropriate controls are utilized to maintain acceptable indoor air quality for building occupants during the course of construction. Properly filter or completely seal off return air to prevent construction dust from entering occupied areas, or getting into the HVAC system.
 - 1) Seal off all ventilation system ducting which is not actively required for temporary heating in construction spaces.
 - d. Filters for any heating or air handling equipment, or similar equipment operated during construction, shall be replaced by the Contractor prior to the Owner re-occupying the space, at no additional cost to Owner.
 - e. Re-lubricate all equipment used.
 - f. All testing, balancing and filter changes, etc., noted in mechanical specifications are still required in addition to any cleaning, changing of filters, etc., performed during temporary operations.
 - g. Should the Owner determine ducts are getting too dirty during construction, the Contractor shall clean inside of ducts by power vacuuming.

3. Pay all costs until final acceptance. Should Owner occupy part of the facilities during construction, the cost of contractor provided utilities will be apportioned upon agreed unit costs.
- E. Temporary Ventilation.
1. Ventilate enclosed areas to exterior to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases. Where/when toxic or volatile materials are used, Contractor shall provide containment within specific work zones and 100% ventilation in an effort to maintain indoor air quality.
 2. Indoor Air Quality and Dust Control: Refer to Section 01 81 19, Indoor Air Quality.
- F. Temporary Telephones and Fax Machine. The Owner will not pay for any costs the Contractor may be required to pay for rewiring or extending wiring to locations for the Contractors use. The Contractor is to arrange for its own direct billing of local and long distance service and pay for all local and long distance service.
1. At the telephone, post a list of important telephone numbers.
 2. The Contractor's Superintendent shall be required to carry a cellular phone with a local area code related to the project area code throughout the duration of the project. The phone shall be always on, except when the Superintendent is at the site office and available to the connected phone.

3.03 TEMPORARY SUPPORT FACILITIES

- A. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.
- B. Field Office. The Owner shall designate a space in the area of the Project for the Contractor to utilize as a temporary field office for Contractor personnel.
- C. At the time of bid, this space has not been designated. However, the Contractor may assume that it is in reasonable proximity to the work area. The Owner will identify an accessible room (as required) for weekly Progress Meetings of sufficient size to accommodate table(s) and chairs for up to (15) attendees.
- D. Temporary Enclosures. Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
1. The Contractor shall be responsible for the determination and maintenance of proper security measures for the job site temporary facilities for the duration of the construction Project including, but not limited to:
 - a. Locks on all construction equipment boxes, temporary storage and office facilities, and construction equipment (vehicles, cranes, dozers, forklifts, etc.).
 - b. Temporary construction cores for all exterior and storage room doors, locksets or cylinders.
 - c. Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism. Contractor is responsible for any theft or vandalism of its materials and equipment.
 - d. The Contractor shall hold the Owner harmless from all damage, vandalism, stolen equipment or supplies on the Project Site for whatever reason, or from injury to or death of unauthorized persons trespassing on Project Site because of inadequate security measures until the Owner releases the Contractor from security responsibilities in writing or at Final Completion, whichever occurs first.
 2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 sq. ft. or less with plywood or similar materials.

3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 4. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.
- E. Project Identification and Temporary Signs.
1. Project Identification Signs: Project signs are not allowed.
- F. Collection and Disposal of Waste. Collect and dispose of waste from construction areas and elsewhere daily. Comply with requirements of NFPA for removal of combustible waste material and debris. Strictly enforce requirements. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully. On-site containers and dumpsters for collection of waste materials, debris, and rubbish will be permitted only in the Contractor's approved areas and must be provided by the Contractor. The type of dumpster and method of disposal shall be determined by the Contractor.
1. Clearance restrictions at the site may prohibit the use of large and/or front-end loaded dumpsters.
 2. Contractor shall supply their own cleaning equipment, dumpsters and barrels. No use of similar Owner items is permitted.
- G. Vehicular Access to the Project Area shall be limited as follows:
1. Do not park vehicles in traffic lanes. Loading and unloading of tools and material will be allowed.
 2. Conduct operations in such a manner to avoid unnecessary interference to existing pedestrian and vehicle traffic.
 3. Access to the construction site is limited. Interfering with existing traffic and pedestrian patterns is not permitted during construction except as permitted by the drawings.
 - a. Do not remove or alter any existing vehicular traffic control, parking, building, or any other signs or devices without obtaining approval from Owner and/or the AHJ.
 - b. Do not install any of the above mentioned type of signs without approval of Owner and/or the AHJ.
 4. The Contractor shall review delivery routes to the construction site to determine any limitations for height or length of delivery vehicles. The Contractor shall be responsible for any damage repair costs caused by either Contractor or subcontractor's vehicles or deliveries to the Contractor or subcontractor's.
 5. Contractor Parking. The Contractor may purchase parking permits from the Owner for any available parking in Owner parking areas.
 - a. Service stalls shall not be used for contractor staff parking. Service stalls are designated for temporary service workers or other communications vehicle, an Owner vehicle, or other short term service parking. Contractor staff shall register with Owner for assigned parking at a space available basis at the prevailing fee per month.
 - b. Parking by the Contractor is not permitted in any stalls designated as "RESERVED", ADA, or otherwise marked, regardless what time of day. Parking citations and/or impounding of vehicles may result from failure to comply with these regulations and will be the sole responsibility of the Contractor.
- H. Construction Aids
1. Provide construction aids and equipment required by personnel to facilitate the execution and inspection of the work.
 - a. Include scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes, protective enclosures, and other such facilities and equipment.
 - b. Refer to respective Sections for particular requirements for each trade.

2. Maintain all facilities and equipment in a first-class condition.
 3. Comply with all applicable requirements specified in Project Manual. Install in accordance with "Quality Assurance" provisions, Specifications and Manufacturer's instructions. Where these may be in conflict, the more stringent requirements govern.
 4. Relocate construction aids as required by:
 - a. Construction progress.
 - b. Storage requirements.
 - c. Accommodation of Owner's legitimate requirements.
 - d. Accommodation of any other Contractor employed at site.
 5. Completely remove temporary materials, equipment and services when construction needs can be met by use of permanent construction, or at Project completion.
 6. Clean and repair damage caused by installations or by use of temporary facilities and clean site areas affected by temporary installations. Restore damaged vegetation.
 7. Restore existing permanent facilities used for temporary purposes to specified or to original conditions.
- O. Cleaning: Refer to Section 01 74 00 Cleaning, for cleaning during construction and final cleaning.

3.04 PROTECTION OF EXISTING FACILITIES AND OCCUPANTS

- A. Contractor shall plan their work to ensure that they complete construction in accordance with the Contract Time allowed while complying with the access and time restrictions established.
- B. Building shall remain accessible to all abled and disabled pedestrian traffic. Contractor shall maintain required means of fire egress throughout the Contract duration.
- C. Indoor Air Quality and Dust Control: Refer to Section 01 81 19, Indoor Air Quality.
- D. Dustproof Partitions and Dust Propagation Prevention
 1. The Contractor shall be responsible for protecting areas outside of the limits of construction from the environment within the limits of construction for the duration of construction. Contractor shall install and maintain dust-proof enclosures and other equipment as required to separate the work area from occupied areas or equipment. Dustproof partitions shall extend floor-to-ceiling, or to structure above where area above the finished ceiling is a return air plenum, providing an air-tight enclosure at each location. Provide partitions with double chamber passage way doors or flaps.
 2. All material used for dust propagation prevention shall be fire-retardant type. Plastic sheeting, if used, shall be a minimum of 6 mils thick.
 3. Provide temporary dust-proof partitions, sealing of existing doors and all other penetrations of the contractor's work area. to confine dust or debris-producing activities for all dust or moisture-producing operations. Include use of portable air filtration equipment in confined spaces where extensive off-gasing and/or dust is expected. Confinement to the immediate work area is mandatory. Type and location of protective measures shall be proposed by the Contractor in accordance with the proposed work plan and be coordinated with the Owner. The building outside of the limits of construction shall be maintained in current operational condition throughout the duration of the project.
 4. Provide negative air machines with venting to the exterior, to assure negative air pressure within the construction work area.
 5. All cutting, grinding, sanding, sweeping and other dust producing activities shall be accomplished wet. Particular attention must be taken to insure that the HVAC system does not become contaminated or spread dust. Dust spreading from the point of origin (including floor and ceiling plenums) must be minimized, even within confines of dust-proof partitions.
 6. Removal of material shall be accomplished in units as large as possible to minimize the dust created by breaking material into smaller pieces.

7. Field cutting of material installed by this project shall be sequenced and located to minimize the impact of dust.
 8. Contractor shall provide dust protection around any staging area outside the Limits of Construction that is within an enclosed building or parking area if area is used for cutting materials. Contractor shall be responsible for damage to parked cars or the building mechanical system caused by dust created in this area.
- G. Odor Control: Project products will contain solvents that when used inside a building, or if used outside can be drawn into the building through the air intake systems. Both situations will be sensitive to occupants within the building. The Contractor shall provide a written procedure for the control of emissions prior to any use. Isolate and vent to the outside if within a building, or provide preventative measures for being drawn into air intakes for areas where solvents are to be used.
- H. Noise and Vibration Control
1. The following environmental performance standards are to be considered a minimum level of requirement for this project, unless local AHJ requirements are more restrictive. The maximum allowable noise levels as measured at the property line of noise impacted uses or activities shall not exceed the following levels:

Maximum Sound Level (dB(A))	Duration of Any One-Hour Period (min)	Applicable Hours**
47	Continually	10 p.m. – 7 a.m.
52	15	
57	5	15*
62	1	10 p.m. – 7 a.m.

* Total not to exceed 15 minutes in any one hour.

** The lower noise levels apply on all hours of weekends and holidays.

2. Maintain the level of construction noise inside adjacent buildings and/or rooms from exceeding 85 dBA during the periods the Contractor is working. Contractor shall meet this criterion by erecting barriers between equipment or job and such interior areas, or by providing equipment noise attenuators.
3. Machinery and Equipment – General: Electric-driven is preferred in place of gas or diesel powered machinery. If noise levels on any equipment cannot reasonably be brought down to criteria, either that equipment will not be allowed on the job or use times will have to be scheduled subject to approval of the Owner. Conformance to this specification shall be included in the Contract price and no compensation shall be allowed for special equipment, overtime, etc., that may be required.
4. Equipment:
 - a. Air Compressors: Equip air compressors with isolating spring base for vibration and silencing packages for noise reduction. Electric-driven preferred.
 - b. The use of core-drilling or saw cutting equipment, or electric driven drills, is required for all demolition. Scabblers and Roto Hammers are permitted. Other pneumatic tools are not allowed without prior approval.
 - c. Arc Welders: No arc welders are to be connected to Owner’s utilities, unless approved by the Owner. Provide separate gas generators for arc welders.
 - d. Limited Hours of Use Within Buildings: Within occupied facilities, noise producing equipment used is subject to approval of Owner and shall be, in general, allowed only before 7 a.m. and after 10 p.m. Specific scheduling is required, with one (1) week advance notice required and approval by Owner.

3.05 OPERATION, TERMINATION, AND REMOVAL

- A. Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
 - 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.
 - 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Unless the A/E requests that it be maintained longer, remove each temporary facility when the need has ended, when 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 the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. At Substantial Completion, clean and restore permanent facilities used during the construction period to its original condition.

END OF SECTION 01 50 00

OUTAGE AND B&G SUPPORT REQUEST FORM

Must be received by Customer Service Center **two working days** prior to outage.
DO NOT BEGIN WORK UNTIL YOU HAVE BEEN NOTIFIED FOR APPROVAL OF THIS REQUEST.
If you have any questions, contact: *CUSTOMER SERVICE CENTER AT 725-0000.*

OUTAGE NUMBER: _____

Building Name: _____ WR Number: _____
Date of Application: ____ / ____ / ____ Requester's Name: _____
Agency: _____ Phone #: _____ Pager #: _____
Date Requested for Outage From: ____ / ____ / ____ To: ____ / ____ / ____
Time Requested for Outage From: ____ : ____ To: ____ : ____ (use 24 hr. clock time)
CHECK AS APPROPRIATE: Regular Hours After Hours Weekend Holiday

Describe the work to be performed (reason for outage): _____

List areas, portions of building(s), grounds, systems, etc., which will be affected: _____

Will permits be required? _____ IF YES, B&G must be contacted and specific approval for work must be obtained. Drawings showing the location must be submitted with this application.

CAPITAL PROJECTS ONLY: Project Name & Number: _____
Contractor(s): _____ Phone #: _____
Property Manager/Site Observer _____ Phone #: _____

Date & Time Received _____ ***Received By (initial)*** _____

APPROVAL and VERIFICATIONS:
B&G Zone Coordinator: _____ Life Safety: _____
Tenant Agencies Contacted: _____

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SECTION 01 61 00

COMMON PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. For requirements peculiar to a given product, material, or piece of equipment, see appropriate technical specification Section.

1.02 DEFINITIONS

- A. Definitions used in this Section are not intended to change the meaning of other terms used in the Contract Documents.
 - 1. Product: "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from the Contractor's previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 2. "Named Products" are items identified by the manufacturer's product name, including such items as a make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
 - 3. "Materials" are products that must be shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
 - 4. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.03 SUBMITTALS

- A. See Section 01 33 00 for submittal requirements.
- B. Proposed Product List:
 - 1. .
 - 2. .
- C. Long-Lead-Time Items
 - 1. Provide copies of purchase orders for long-lead-time items to the Architect within twenty (20) days after receipt of Notice to Proceed.
 - 2. Forward copies of acknowledgment, production and shipping schedules to Architect as they are received for all required items.
- D. Submit three (3) copies in conformance with provisions of Article 2.03 below.

1.04 QUALITY ASSURANCE

- A. To the fullest extent possible, provide products of the same kind from a single source.

- B. When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options. Compatibility is a basic general requirement of product/material selections.
- C. Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior. Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All access routes, staging areas, loading restrictions, and other uses of the building shall be coordinated and approved by the A/E and Owner prior to the start of work. Ease of access to the building is limited and should be verified prior to moving materials.
- B. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
 - 1. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing to prevent damage, deterioration, loss or theft. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage. Where appropriate, submit MSDS for all delivered products.
 - 2. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 - 3. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
 - a. Store with lids sealed, outside of building, all glues, adhesives, sealers, caulking, mastics, cleaners, paints, thinners and related flammable and hazardous materials.
 - 4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that quantities are correct and that products are undamaged and properly protected. Reject damaged and defective items.
 - 5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units. Store and protect in accordance with manufacturers' instructions, with seals and labels intact and legible.
 - 6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
 - 7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.
 - 8. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 - 9. Prevent contact with material that may cause corrosion, discoloration, or staining.
 - 10. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.06 JOB CONDITIONS

- A. Pre-Installation Conferences
 - 1. At each meeting review progress of other work and preparations for particular work under consideration, including requirements of Contract Documents, options, related change orders, purchases, deliveries, shop drawings, product data, quality control samples, possible conflicts, compatibility problems, time schedules, weather limitations, temporary facilities, space and access limitations, structural limitations, governing regulations, safety, inspection and testing requirements, required performance results, recording

- requirements, and protections.
2. Record attendees, signification discussions of each conference, and agreements and disagreements, along with final plan of action; distribute record of meeting promptly to everyone concerned including A/E and Owner.
 - a. Do not proceed with the work if associated pre-installation conference cannot be concluded successfully.
 - b. Instigate actions to resolve impediments to performance of the work, and reconvene conference at earliest date feasible.
 3. Discuss any pertinent issues at the weekly Progress Meetings; see Section 01 31 19 Project Meetings.

PART 2 - PRODUCTS

2.01 GENERAL PRODUCT REQUIREMENTS

- A. Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
 1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
 2. Standard Products: Where available, provide standard products of types which have been produced and used previously and successfully on other projects and in similar application.
 3. Color and Appearance Consistency of Finish Materials: All finish materials of their respective kinds, in regards to construction phasing, shall be consistent in color and appearance throughout the total Project and shall be purchased out of one dye lot, production run, batch, etc., as applicable, for the total Project for each respective material.
- B. Additional Requirements: Material and equipment incorporated in to the work:
 1. Shall conform to applicable specifications and standards.
 2. Shall comply with size, make, type and quality specified or as specifically approved in writing by Architect.
 3. Shall be free of ASBESTOS, FORMALDEHYDE and LEAD.
 4. Manufactured and Fabricated Products:
 - a. Design, fabricate, and assemble in accordance with first-class "Workmanship" as defined in these Contract Documents.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges; parts to be interchangeable.
 - c. Two or more items of the same kind to be identical and by same manufacturer (whether furnished under one Section or more).
 - d. Products shall be suitable for service conditions.
 - e. Adhere to indicated equipment capacities, sizes, and dimensions unless variations are specifically approved in writing.
 - f. Except where field finishing is specified or otherwise required, products and fabricated items shall be pre-finished off-site.
 5. Do not use materials and equipment for other than designed or specified purposes and uses.
- C. Nameplates: Except as otherwise indicated for required approval labels, and operating data, do not permanently attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view either in occupied spaces or on exterior of the work.
 1. Labels: Locate required labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface which, in occupied spaces, is not conspicuous.

2. Equipment Nameplates: Provide permanent nameplate on each item of service-connected or power-operated equipment. Indicate manufacturer, product name, model number, serial number, capacity, speed, ratings and similar essential operating data. Locate nameplates on an easily accessed surface which, in occupied spaces, is not conspicuous.

2.02 PRODUCT SELECTION

- A. The Contract Documents and governing regulations govern product selection. Procedures governing product selection include the following:
 1. Proprietary Specification Requirements. Where only a single product or manufacturer is named, or indicates "no equals", "no substitutions", or "no exceptions", provide the product indicated. Notify A/E if it is discovered that the named product does not comply with the contract documents, or is not appropriate for the function intended.
 2. Semi proprietary Specification Requirements. Where two or more products or manufacturers are named, or indicates "no equals", "no substitutions", or "no exceptions", provide one of the products indicated. Notify A/E if it is discovered that none of the named products complies with the contract documents, or is not appropriate for the function intended.
 3. Nonproprietary Specification Requirements. Where the Specifications list products or manufacturers, or indicates "or approved equal" or "other acceptable", comply with Contract Document provisions concerning PRODUCT SUBSTITUTION to obtain approval for use of another product.
 4. Descriptive Specification Requirements. Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
 5. Performance Specification Requirements. Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated. Submit manufacturer's recommendations contained in published product literature or by the manufacturer's certification of performance for approval by A/E.
 6. Visual Matching. Where matching an established sample is required, the A/E's decision will be final on whether a proposed product matches satisfactorily.
 - a. Where there is no product available within the specified category which matches satisfactorily and also complies with other specified requirements, comply with the provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category.
 7. Visual Selection. Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures ..." or similar phrases, select a product and manufacturer that complies with other specified requirements. The A/E will select the color, pattern, and texture from the product line selected.

2.03 PRODUCT SUBSTITUTION

- A. General Provisions
 1. The requirements for substitutions do not apply to specified Subcontractor options on products and construction methods. Revisions to Contract Documents, where requested by Owner or Architect, are "changes" not "substitutions".
 2. Subcontractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute "substitutions" and do not constitute a basis for change orders, except as provided for in contract documents. Otherwise, the Subcontractor's requests for changes in products, materials and methods of construction required by contract documents are considered requests for "substitution", and are subject to requirements hereof.
 3. If a bidder or Contractor desires approval of some material or product other than that specified, it shall submit a written request for approval of the substitute item in accordance with the following requirements:

- a. All such requests must be made on the SUBSTITUTION REQUEST FORM at end of this Section. Where specifications specify a product color and/or pattern, Contractor shall include a sample of proposed product/item at a size appropriate to make an evaluation with the specified product.
 - b. No request for approval will be considered unless submitted in accordance with this Section.
 - c. Final decision as to whether an item is an equal or satisfactory substitution rests with Owner.
4. Every substitution request must state whether the item offered is equal or equivalent to the specified product. The substitute material or product must be accompanied by its reference in the Contract Documents and complete catalog, technical and other information. If applicable, include samples showing comparison of physical and other pertinent characteristics as required to establish equivalence of acceptability for the proposed application. Where specific test results are required by the Contract Documents, the comparison data for the proposed item shall be based upon the same test methods as those specified, or they shall be correlated to clearly demonstrate comparability. The same guarantee described for the specified product is required for the substitution.
- B. Substitutions – During Bidding Period: During the Bid period, submit substitution requests for approval of substitute materials or products, for all items indicated as proprietary or “approved equal” semi-proprietary. All requests shall be received by A/E no later than seven (7) days, or as indicated elsewhere in the Contract Documents, prior to scheduled time for receipt of bid in order to receive consideration. Bidders will be informed by addendum of additional materials and products approved for use. No other form of approval will be given during the bid period and bidders shall not rely upon any approval not incorporated into the Contract Documents in this manner.
- C. Substitutions – After Starting Work: After Contract Award, requests for approval of substitute materials or products for all items indicated as proprietary, semi-proprietary or “approved equal” will not be considered, unless one or more of the following conditions exists. With its request, Contractor shall indicate which condition it believes applies.
1. Unavailability. A substitution is required because the specified item is not available, due to factors beyond the control of Contractor. (Unavailability due to late order is not cause for substitution requests).
 2. Unsuitability. Subsequent information or changes disclose inability of the specified item to perform as intended.
 3. Regulatory Requirements. Final interpretation of Code, regulatory requirements, safety requirements, or insurance requirements necessitate a change due to inability of the specified item to conform.
 4. Warranty. Manufacturer or fabricator cannot certify or warrant performance of specified item as required.
 5. Owner's Benefit. In the judgment of the Contractor, acceptance of the proposed substitution is clearly in Owner's best interest because of cost, quality, or other consideration. In requesting a substitution under this clause, Contractor shall furnish substantiation of any such reason and proposed credit.
- D. Substitution requests for approval of substitute materials or products for all items **not** followed by restrictive language will be considered if the Contractor submits information and documentation as required by 2.03C above. The proposed product or material shall be equal or equivalent to the specified item and shall be subject to the same redesign and coordination as all substituted items.
1. Substitution requests submitted for an unnamed, non-prior approved product/manufacturer where such products are specified by the listing of three or more named approved products/manufacturers, shall be accompanied with a check in the amount of \$100, made payable to the A/E for additional time required to research and evaluate such

unnamed product/manufacturer. Such payment will only afford review of such a submittal and does not guaranty said proposed substitute product/ manufacturer will be approved.

- E. In making request for approval of substitute materials, the Bidder/Contractor shall represent that it has investigated the proposed product and, in its opinion, it is equal or superior in equivalence in all respects to that specified. Also, Contractor shall coordinate all trades including changes thereto as may be required, that it waives all claims for additional costs which subsequently become apparent as a consequence of the substitution, and that it will bear all costs related hereto, including costs of A/E's services for redesign, if deemed necessary.
- F. Substitutions will not be considered if they are indicated or implied on Shop Drawings or other project data submittals, without proper notice shown on the SUBSTITUTION REQUEST FORM at the end of this Section. Submissions received that include products or manufacturers not listed in the specifications or approved on the form during the bid period will be returned and marked "Revise and Resubmit".
- G. Action By A/E
 - 1. During Bidding Period: If the A/E approves any proposed substitution, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.
 - 2. After Start of Work:
 - a. Within one week of receipt of Contractor's request for substitution, the A/E will request whatever additional information or documentation may be needed for their evaluation of the request.
 - b. Within two weeks of receipt of request, or within one week of receipt of requested additional information or documentation (whichever is later), the A/E will notify the Contractor of either their acceptance or rejection of the proposed substitution.
 - 1) Rejection will be the endorsement on the form provided by the Contractor and will include statement of the reasons for rejection (non-compliance with the requirements for requested substitutions, or other reasons as detailed).
 - 2) Acceptance will be the endorsement on the form provided the Contractor.

PART 3 - EXECUTION

3.01 INSPECTIONS & ACCEPTANCE OF SUBSTRATES

- A. Installer's Inspection of Conditions
 - 1. Require Installer of each major unit of work to inspect substrate to receive the work, and conditions under which the work will be performed, and to report (in writing to Contractor) unsatisfactory conditions.
 - 2. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
 - 3.
- B. Contractor's Inspection. Inspect each item of material or equipment immediately prior to installation, and reject damaged and defective items.

3.02 GENERAL INSTALLATION PROVISIONS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

1. When Contract Documents require installation of work to comply with Manufacturer's printed instructions, obtain and distribute instructions to concerned parties, including A/E, and field office, before starting that particular work.
 2. Until project is complete, maintain at jobsite one (1) set of complete installation and maintenance instructions for materials and equipment.
 3. Handle, install, connect, clean, condition and adjust products in accordance with Manufacturer's recommendations, directions and specified requirements.
 - a. Should job conditions or specified requirements conflict with Manufacturer's instructions, consult with A/E for further instructions.
 - b. Do not proceed with work without clear instructions.
 4. Perform work in accordance with Manufacturer's instructions. Do not omit any preparatory step or installation procedure unless it is:
 - a. Verified with and accepted by A/E in writing.
 - b. Specifically modified or exempted by Contract Documents.
 - c. Perform additional requirements that are specified which are greater than the manufacturer's requirements and do not have a deleterious affect on the product being installed.
- B. Owner-Furnished Products
1. Refer to Drawings and/or Section 01 11 00 for identification of Owner furnished products.
 2. Owner's Responsibilities:
 - a. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - b. Arrange and pay for product delivery to site.
 - c. On delivery, inspect products jointly with Contractor.
 - d. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - e. Arrange for manufacturers' warranties, inspections, and service.
 3. Contractor's Responsibilities:
 - a. Review Owner reviewed shop drawings, product data, and samples.
 - b. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - c. Handle, store, install and finish products.
 - d. Repair or replace items damaged after receipt.
- C. Attachment & Connection Devices & Methods
1. Provide attachment and connection devices and methods necessary for anchoring work securely and properly in place as it is installed; install true to line and level, and within recognized industry tolerances if not otherwise indicated.
 2. Allow for expansions and building movements.
 3. Provide uniform joint widths in exposed work, organized for best possible visual effect. Refer questionable visual-effect choices to A/E for final decision.
- D. Precautions
1. Acclimate product to room conditions as required by standard specifications and/or as recommended by manufacturer.
 2. Install work during conditions of temperature, humidity, exposure, forecasted weather, and status of project completion which will ensure best possible results for each unit of work, in coordination with entire work.
 3. Isolate each unit of work from non-compatible work, as required to prevent deterioration.
 4. Re-check measurements and dimensions of the work, as an integral step of starting each installation.

5. Coordinate enclosure (closing-in) of work with required inspections and tests, so as to avoid necessity of uncovering work for that purpose.
- E. Mounting Heights: Except as otherwise indicated in the Contract Documents, mount individual units of work at industry recognized standard mounting heights, for applications indicated. Refer questionable mounting height choices to A/E for final decision.
- F. In-Place Protection
 1. General
 - a. During handling and installation of work at project site, clean and protect work in progress and adjoining work on a basis of perpetual maintenance.
 - b. Apply suitable protective covering on newly installed work where reasonably required to ensure freedom from damage or deterioration at time of Substantial Completion; otherwise, clean and perform maintenance on newly installed work as frequently as necessary through remainder of construction period.
 - c. Adjust and lubricate moving components to ensure operability without damaging effects. Contractor is responsible for function, condition and unblemished appearance of all work on Project, and any item or work judged defective by A/E shall be subject to replacement at no additional cost to Owner.
 2. To extent possible through reasonable control and protection methods, supervise performance of work in a manner and by means which will ensure that none of the work, whether completed or in progress, will be subjected to harmful, dangerous, damaging, or otherwise deleterious exposures during construction period.
- G. Replacement:

END OF SECTION 01 61 00

SUBSTITUTION REQUEST FORM

TO: [Design Firm]
[Address]
[City, Zip Code]

ATTN: Project Manager

PROJECT NAME: _____

CONTRACTOR: _____

We hereby submit for consideration, the following product instead of the specified items for above project:

SECTION	PARAGRAPH	SPECIFIED ITEM
_____	_____	_____

Proposed substitution: _____

Attach complete dimensional information and technical data, including laboratory tests, if applicable.

Include complete information on changes to Drawings and Specifications which proposed substitution will require for its proper installation.

Submit with request all necessary samples and substantiating data to provide equal quality, performance, and appearance to that specified. Clearly mark Manufacturer's literature to indicate equality or equivalence in performance. Indicate differences in quality of materials and construction.

Fill in blanks below:

A. Does the substitution affect dimensions shown on Drawings:

___ No ___ Yes. If yes, clearly indicate changes:

B. Will the undersigned pay for changes to the building design, including engineering and detailing costs caused by requested substitution?

C. What effect does substitution have on other trades, other Contracts, and contract completion date?

D. What effect does substitution have on applicable code requirements?

E. Differences between proposed substitution and specified item.

F. Manufacturer's warranties of the proposed and specified items are:

Same Different(explain) _____

G. List of names and addresses of 3 similar projects on which product was used, date of installation, and A/E's name and address. (Attach list with requested information)

H. Cost impact: _____

Undersigned attests function and quality are equal or equivalent to specified items.

CERTIFICATION OF EQUAL OR EQUIVALENT PERFORMANCE AND ASSUMPTION OF LIABILITY FOR EQUAL OR EQUIVALENT PERFORMANCE

Signature

Date _____

Firm

Address

Telephone

Fax

Signature must be by person having authority to legally bind Contractor to the above terms.

For Use by A/E: **Accepted** **Not Accepted**
 Accepted As Noted **Received Too Late**

END OF FORM

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

- A. General Contractor is responsible for all cutting, fitting, and patching, required to complete the Work and to:
1. Make its several parts fit together properly;
 2. Join new work to existing work;
 3. Uncover portions of the Work to provide for installation of any ill-timed work;
 4. Remove and replace defective work;
 5. Remove and replace work not conforming to requirements of Contract Documents;
 6. Remove samples of installed work as specified for testing;
 7. Provide routine penetrations of non-structural surfaces for installation of piping, ductwork, and electrical conduit.
 8. For installation of rooftop mechanical equipment.
- B. In addition to selective demolition specified in Section 02 41 19 and that specifically shown, cut, move or remove items necessary to provide access or to allow alterations and new work to proceed. Include such items as:
1. Removal of abandoned items and items serving no useful purpose, such as abandoned piping, conduit and wiring, and miscellaneous brackets, hardware and the like.
 2. Cleaning of surfaces, and removal of surface finishes as needed to install new work and finishes.
 3. Repair or removal of hazardous or unsanitary conditions.
- D. For additional requirements for cutting and patching see respective Specification Sections.

1.03 DEFINITIONS

- A. "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.
1. "Cutting and patching" is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.
 2. Cutting and patching performed during the manufacture of products, or during the initial fabrication, erection or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners and similar operations are also not considered to be "cutting and patching".
 3. "Selective Demolition" is recognized as related-but-separate categories of work, which may or may not require cutting and patching as defined in this Section.

4. See respective Specification Sections for additional definitions and requirements pertaining to Cutting and Patching.

1.04 SUBMITTALS

- A. Submit written request to Owner and A/E a minimum of 48 hours in advance of executing any cutting and alteration affecting:
 1. The work of the Owner or any separate Contractor;
 2. Structural value or integrity of any element of Project;
 3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems;
 4. Efficiency, operational life, maintenance, or safety of existing operational elements;
 5. Visual quality of sight-exposed elements.
 6. Exterior weather protective finish.
 7. Historical elements defined in the Contract Documents.
- B. Include with Request:
 1. Project identification;
 2. Description of affected work and products to be used;
 3. Necessity for cutting;
 4. Effect on work of Owner or any separate Contractor;
 5. If structural modifications is a contractor alternative to work shown in the Contract Documents, the Contractor shall retain and submit calculations of a Washington State registered structural engineer that the proposed work will not change the load-carrying capacity or load-deflection ratio of the structural element;
 6. Weatherproof integrity of Project;
 7. Description of proposed work designating extent of cutting, patching or alteration. Include the following:
 - a. name trades to be executing the Work;
 - b. products proposed to be used;
 - c. extent of refinishing to be done;
 - d. alternatives to cutting and patching;
 - e. where cutting and patching involves adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with the original structure.
 - f. cost proposal (when applicable);
 - g. written permission of any separate Contractor whose work will be affected;
 - h. list of utilities that will be disturbed or otherwise affected by Work. Indicate duration of disruption.
- C. Should work conditions or schedule indicate change of products from original installation, submit substitution request as specified in Section 01 61 00.
- D. Submit written notice to A/E designating date and time work will be uncovered.
- E. Approval by the A/E to proceed with cutting and patching does not waive the A/E's right to later require complete removal and replacement of unsatisfactory work.

1.05 QUALITY ASSURANCE

- A. Requirements For Structural Work: Do not cut-and-patch structural work in a manner resulting in reduction of load-carrying capacity or load/deflection ratio; submit proposed cutting and patching of structural elements to Architect for structural approval before proceeding.
- B. Operational & Safety Limitations: Do not cut-and-patch operational elements and safety-related components in a manner resulting in reduction of capacities to perform in manner intended, including energy performance, or resulting in decreased operational life, increased maintenance, or decreased safety.

- C. Visual Requirements: Do not cut-and-patch work which is exposed on exterior or exposed in occupied spaces of buildings, in a manner resulting in reduction of visual qualities or resulting in substantial evidence of cut-and-patch work, both as judged solely by Architect. Remove and replace work judged by Architect to be cut-and-patched in a visually unsatisfactory manner.
- D. Water Tight Installation: Cut and patch work shall restore elements of the exterior envelope to vapor tight and water tight condition.

1.06 WARRANTY

- A. Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.
- B. Salvaged Materials: Salvage sufficient quantities of cut or removed material to replace damaged work of existing construction, when material is not readily obtainable on current market.
 - 1. Store salvaged items in a dry, secure place on site, or deliver to Owner as noted.
 - 2. Items not required for use in repair of existing work shall remain the property of Owner at the Owner's option; otherwise they shall become Contractor's salvage.
 - 3. Salvaged items to be re-used shall be cleaned, refinished, etc., as appropriate before reinstallation.
 - 4. Do not incorporate salvaged or used material in new construction except where specifically indicated or with written permission of A/E.
 - 5. Refer to other sections for salvage requirements that may be more stringent.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.
 - 1. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- B. Prior to cutting into existing concrete or masonry, the Contractor may be required to conduct X-ray inspections to verify location of existing internal conditions (conduit, structural steel, etc.) to ensure that they will not be damaged during cutting and demolition work.
- C. After uncovering work, inspect condition affecting product installations and work performance. Advise A/E in writing if there are conditions which will change the Contract Document requirements.

3.02 PREPARATION

- A. Provide adequate temporary support of work to be cut to assure structural integrity of affected work and safety for Contractor and Owner personnel.
- B. Protect existing and adjoining construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

- A. Employ skilled workmen to perform cutting and patching. Skilled shall mean workmen trained in the installation and repair of the specific material(s) impacted.
- B. Execute cutting and removals by methods preventing damage to other work. Use core drilling equipment and diamond saws for cutting required openings in concrete and masonry. Provide proper surfaces to receive installation of repairs.
- C. Work shall be performed by or under the direct supervision of the General Contractor and only by specialists or workers skilled in the necessary trades for materials requiring cutting and patching. Employ qualified installer or fabricator to perform cutting and patching for sight-exposed finished surfaces. The General Contractor shall be responsible for obtaining approval from the A/E for all cutting in and around any surface that is identified in the documents as an historically significant area or specifically noted otherwise. See Section 01 35 91 for additional requirements and procedures pertaining to historic materials.
- D. Execute fitting and adjustment of products to provide finished installations complying with specified products, functions, tolerances, and finishes.
- E. Restore cut or removed work. Install new products as required to complete work in accordance with Contract Documents. Quality of patched or extended work shall be not less than that specified for new work.
- F. Fit work air-tight to pipes, sleeves, ducts, conduit, and other surface penetrations. Maintain required clearance around pipe in accordance with National Fire Protection Association NFPA-13. Provide required firestopping in conjunction with patching.
- G. Refinish entire surfaces as necessary to provide even finish matching adjacent finishes:
 - 1. For continuous surfaces, refinish to nearest intersection.
 - 2. For an assembly, refinish the entire unit.

3.04 CUTTING

- A. Only saw cutting or core drilling of concrete and masonry are permitted; no jack hammering, unless an exception is requested by the Contractor and approved by the Owner., hammering, or chopping. Limited use of roto hammers is acceptable. Use of these pieces of equipment shall occur when the building occupancy is at its lowest in the space adjoining the work. See Specification Section 01 50 00 – 3.04H for requirements related to cutting equipment.
- B. Cut existing construction using methods least likely to damage elements retained or adjoining construction.

1. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit flush with remaining wall, floor, or ceiling to prevent entrance of moisture or other foreign matter after by-passing and cutting.
4. Monitor cutting to detect any movement of surrounding work after cutting has occurred.
5. Cutting of any surface identified as historical shall be observed by the A/E and not begun prior to A/E approval.

3.05 PATCHING

- A. Except as specified otherwise, all patching is the responsibility of the applicable trade and performed under the direction of the Contractor. All patching shall conform to the requirements set forth herein and to the standards set forth in these Contract Documents for applicable like work and materials.
- B. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
 1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 2. Patching shall match existing or adjacent surfaces, and shall match existing materials and assemblies so as to retain all existing fire ratings. Existing walls, floors, ceilings, beams and other building surfaces shall be neatly finished by patching, filling or otherwise as directed by the A/E.
 3. 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.
 4. Where removing walls or partitions extending from one finished area into another, patch and repair floor and wall surfaces at the removed area to obtain a uniform transition between any adjoining spaces. Provide an even surface of uniform color and appearance. If necessary to achieve uniform color and appearance, remove existing floor, wall and ceiling coverings and replace with new materials.
 5. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 6. Fit work air-tight to pipes, sleeves, ducts, conduit, and other surface penetrations.
 7. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material allowed in these specifications to full thickness of the penetrated element.
 8. Roof Patching After Installation of Rooftop Mechanical Equipment: Replace roofing membrane, insulation and other components with like products that maintain the warranty of the existing systems
 9. When finished surfaces are cut in such a way that a smooth transition with new work is not possible, terminate existing surface in a neat manner along a straight line at a natural line of division, and provide trim appropriate to finished surface as approved by A/E.
- C. Refinish entire surfaces from corner to corner or to change in material as necessary to provide an even finish matching adjacent finishes.
 1. For continuous surfaces, refinish to nearest intersection.
 2. For an assembly, refinish the entire unit.

3.06 CLEANING

- A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
 - 1. Clean common areas on a daily basis that may be used by occupants.

END OF SECTION 01 73 29

SECTION 01 74 00

CLEANING

PART 1 - GENERAL

1.01 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.

1.02 DESCRIPTION

- A. This Section includes administrative and procedural requirements for cleaning and protection during construction and final cleaning at Substantial Completion.
- B. Related Requirements: Coordinate related requirements specified in other parts of the Project Manual; special cleaning requirements for specific construction elements are included in appropriate Sections of Divisions 02 through 28, as applicable.

1.03 QUALITY ASSURANCE

- A. General Cleaning Requirements: Conduct cleaning and waste disposal operations in compliance with governing laws, codes, and ordinances. Comply fully with Federal and Local environmental and anti-pollution regulations.
 - 1. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
 - 2. Burning or burying of debris, rubbish, or other waste material on premises is not permitted.
- B. Conform to State safety regulations (WISHA requirements).
- C. Documentation of waste management, spill response, procedures and contingency plans to be made available to Owner's Representative upon request.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cleaning Agents (for non-historic materials and spaces)
 - 1. Use only cleaning agents and methods recommended by Manufacturer of surface material to be cleaned.
 - 2. Use cleaning materials only on surfaces recommended by cleaning material Manufacturer; Do not use cleaning materials damaging to surfaces.
 - 3. Do not use cleaning materials creating hazards to health or property.

PART 3 - EXECUTION

3.01 CLEANING & PROTECTION DURING CONSTRUCTION

- A. General:
 - 1. Contractor and each subcontractor at all times shall keep the premises free from accumulation of waste materials, debris and rubbish caused by their operations.

2. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
 3. Execute periodic cleaning. Keep work area free from accumulation of construction waste materials and rubbish.
 4. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
 5. Provide on-site containers for collection of waste materials, debris, and rubbish.
 6. Allow no debris, broken or open cartons, or other refuse to collect in the project or around it; allow no inflammable or hazardous materials to be stored on the site without approved fire protection precautions and procedures.
- B. Waste Removal: Remove all waste materials, debris and rubbish from site periodically and dispose of at legal disposal areas away from the site, at Contractor's expense.
- C. Street and Parking Area Cleaning: Immediately clean all spilled material which results from the work of this Contract and waste hauling operations; use motorized equipment and hand labor as required. Remove from streets, driveways or parking areas in time to prevent such materials from affecting traffic or clogging street drainage system; clean any drains thusly contaminated.
- D. Non-Compliance: If the Contractor fails to enforce clean-up procedures, the Owner may do the cleanup and the cost thereof shall be charged to the Contractor and/or subcontractors, as applicable, as provided in Paragraph 3.4 of the General Conditions.
- E. Dust Control
1. Clean interior spaces prior to start of finish painting. Continue cleaning on an "as-needed" basis until painting is finished.
 2. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.
 3. Control site dust as necessary to meet local jurisdiction requirements.

3.02 FINAL CLEANING

- A. Provide final cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected in a normal commercial building cleaning and maintenance program, complying with manufacturer's instructions.
- B. Cleaning to include all exposed surfaces and materials within the limits of construction, whether installed by the Contractor, installed by the Owner, or existing prior to the beginning of this project.
1. The extent of cleaning existing facilities (remodel and/or addition projects) shall apply only to those areas of new work, or existing areas impacted by the construction activities, even if simply due to workmen passing through the space.
- C. Complete the following cleaning operations before requesting review for certification of Substantial Completion for the entire Project or a portion of the Project. Cleaning shall include adjacent existing surfaces, such as, but not limited to, walls, floors, ceilings and glazing, that have been affected by the construction activity.
1. Remove petrochemical spills, stains, and other foreign deposits.
 2. Remove tools, construction equipment, machinery, and surplus material from the site.
 3. Clean exposed hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition.

4. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 5. Broom and mop clean concrete floors and floors finished with V.C.T., sheet vinyl, and similar surfaces.
 6. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo, if required.
 7. Clean transparent materials, including mirrors and glass (both sides) in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 8. Remove labels that are not permanent labels.
 9. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 10. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 11. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 12. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 13. Clean ducts, blowers, and coils if units were operated without filters during construction.
 14. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
 15. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
 16. Leave the Project clean and ready for occupancy.
- D. Removal of Protection: Remove temporary protection and facilities installed for protection and administration of the work during construction. Restore landscaping and other repair as necessary or required.
- E. Compliances: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner. Do not use Owner's containers for trash generated by cleaning or construction.
1. Where extra materials of value remaining after completion or associated work have become Owner's property, arrange for disposition of these materials as directed.

END OF SECTION 01 74 00

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Demolition and Construction Waste Management Plan SAMPLE

Project Name: Student **Hall Contact/Phone:** Joe Smith / (206) 555-2222

Expansion

Project Location: Washington Community College, Green City

Material	Estimated Quantity	Proposed Disposal Method	Proposed Handling Procedure	Hauler
Demolition				
Asphalt from parking lot	100 tons	Ground on-site, use as fill		
Wood framing	6 tons	Recycle - Wood Recycling NW	Separate into "clean wood" dumpster, nails ok.	A
Decorative wood beams	300 bd.ft.	Salvage - Green City Salvage	Remove by hand, store on site, on pallets, for pick up.	C
CMU block	60 tons	Ground on-site, use as fill		
Ceiling tile	10,000 SF	Recycle - A-1 Ceiling Tile	Remove whole, Stack on pallets and shrink wrap for pick up.	E
Metal track	4 tons	Recycle - Green City Metals	Separate into "metals" dumpster.	A
Doors	40	Salvage - Green City Salvage	Work with salvage company to remove by hand.	C
Sheet rock	30 tons	Recycle - Green's Gyp Recycle	Separate into "Gypsum Board" dumpster, no lead paint.	A
Carpet	30 CU YDS	Recycle - D-2 Carpets	Separate into "Carpet" dumpster, provided by D-2.	B
Fluorescent lamps	1,000	Recycle - Green's Hazardous Wst.	Use boxes and store in dry location on site for pick up.	A
Fluorescent ballasts	400	Recycle - Green's Hazardous Wst.	Use in drums and store in dry location on site for pick up.	A
Remaining wastes	8 tons	Garbage - City Disposal	Dispose in "trash" dumpster.	D
New Construction				
Concrete, brick & CMU	10 tons	Recycle - Green's Quarry	Break up (2' minus) and put in "concrete" dumpster.	A
Forming boards		Reuse then recycle - Wood Recy.	Reuse, then put in "clean wood" dumpster	A
Clean wood scrap	4 tons	Recycle - Wood Recycling NW	Separate into "clean wood" dumpster, nails ok.	A
Sheet rock	8 tons	Recycle - Green's Gyp Recycle	Separate into "Gypsum Board" dumpster, no lead paint.	A
Scrap metal	4 tons	Recycle - Green City Metals	Separate into "metals" dumpster.	A
Cardboard	10 CU YDS	Recycle - Green City Recycle	Separate into "cardboard" dumpster.	A
All other wastes	8 tons	Garbage - City Disposal	Dispose in "trash" dumpster.	D

Haulers: A - Acme Hauling D - City Disposal
 B - EZ Carpet recycling E - A-1 Ceiling Tile
 C - Green City Salvage

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SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 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.

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:
 - 1. Training of Owner's personnel.
 - 2. Maintenance Materials submission.
 - 3. Substantial Completion.
 - 4. Final Acceptance.

1.03 SEQUENCE OF CLOSE-OUT

- A. The Contractor's superintendent shall perform a review of all installed work (general, mechanical, electrical) and note any corrections, touch-up, or otherwise restore marred, exposed surfaces, that is necessary to comply with the Contract Document requirements before requesting the A/E to review the Work. The Contractor shall develop a written correction list (pre-punch list) and track the completion of the items by initialing and dating each item, signifying that it has been reviewed and properly completed.
- B. Comply with items under SUBSTANTIAL COMPLETION by submitting documentation and the Contractor's initialed correction list to the A/E with a letter requesting the A/E's review of the project.
- C. Upon receipt of the information from the Contractor, the A/E will visit the site and review the Project with the Owner for compliance with the Contract Documents. The A/E will develop a punch-list of any work that still needs corrections. If the list is incidental corrective punch work to complete, the A/E will issue the notice of Substantial Completion with the corrections list attached. If the correction work is still significant, the Contractor shall complete the corrections in the same format as its pre-punch list and request additional reviews by the A/E as necessary to establish that the Project is complete to the point where the Substantial Completion notification can be issued.
- D. Provide operation and maintenance instruction on installed equipment to Owner designated staff.
- E. The Contractor shall correct any outstanding punch list items and submit all other close-out documentation to the A/E as indicated under FINAL ACCEPTANCE. When punch lists have been verified by the A/E as being complete and all documentation is satisfactory and accepted by the A/E, the A/E will issue its notification of Final Acceptance.
- F. Upon receipt of the A/E's notification of Final Acceptance, E&AS will advertise the Project as being accepted, starting the 45 day lien period.

1.04 PROJECT RECORD DOCUMENT SUBMITTAL

Refer to Section 01 78 00, Closeout Submittals.

1.05 OPERATION AND MAINTENANCE MANUALS

Refer to Section 01 78 00, Closeout Submittals.

1.06 OPERATING INSTRUCTION OF OWNER'S PERSONNEL

- A. The Contractor shall provide for operating and maintenance instruction of Owner's personnel for items installed under this contract. Contractor shall provide for this instruction at a mutually agreeable time and place, which may be outside of Contractor's normal working hours.
1. Prior to any training, the Contractor is to complete all system start-up and functionality testing. The Contractor/Sub-contractor will then assist the A/E to review and confirm the systems are performing in accordance with the Contract Documents. If the documents identify that systems will be commissioned, the Owner may elect to have the commissioning agent also perform the functionality review with the Contractor. If commissioning is required, this will be completed prior to the Contractor and major subcontractors providing qualified personnel for conducting full on-site operation and maintenance training and instruction to Owner's designated user personnel and maintenance crews. Instruction shall include the proper operation, adjustment and maintenance of all general, mechanical and electrical operating systems and equipment. Contractor shall schedule this period in advance with the Owner and appropriate subcontractor or vendor's representative. This shall be scheduled two (2) weeks after submittal of the final Operating and Maintenance Manuals so that such information will be available for Owner staff familiarization prior to the time of this instructional period. Provide a minimum of (8) hours of such training and instructions on site, unless otherwise directed, conducted to Owner's satisfaction. Such instruction shall be given in time blocks not exceeding (4) hours in any one-day and shall be exclusive of off-site factory training for such items as the energy management system.
 2. At each training session, provide a sign-in sheet for signature of all Owner staff that attend. Identify the sign-in sheet with the training being provided and the date of the training. Submit the sign-in sheet(s) with FINAL ACCEPTANCE procedure.
 3. Except as otherwise specified, arrange for each installer of work requiring continuing maintenance or operation to meet with Owner's personnel at project site to provide basic instructions needed for proper operation and maintenance of entire work. Include instructions by manufacturer's representatives where installers are not expert in the required procedures.
 4. Use operation and maintenance manuals as the basis for instruction. Review contents of manual with personnel in full detail to explain all aspect of operations and maintenance; include as a minimum record documentation, tools, spare parts and materials, lubricants, fuels, identification system, control sequences, hazards, cleaning and renewal of finishes, and similar procedures and facilities.
 5. For operational equipment, demonstrate start-up, shut-down, emergency operations, noise and vibration adjustments, safety, economy/efficiency adjustments, and similar operations. Review maintenance and operations in relation with applicable warranties, agreements to maintain bonds, and similar containing commitments.
 6. All equipment operation and maintenance instructions and training shall be video taped in a professional manner, at the expense of the Contractor, and the edited film delivered with documents for FINAL ACCEPTANCE.
 7. In addition, provide (4) hours training for the energy management system.
 8. Provide a minimum of (4) hours additional follow-up training sessions to be conducted four (4) months following initial training. Systems/equipment to be covered under these training sessions shall be as determined by the Owner.
 9. In addition to or in conjunction with these training sessions, provide for (4) seasonal adjustment training sessions of the energy management system.

- B. The Contractor shall submit a training synopsis for each system required under the Contract Documents to review operations and maintenance instruction and training. Submit training synopsis with each respective preliminary Operation and Maintenance Manual submittal. Each synopsis shall be reviewed by the A/E and approved or returned with comments if necessary. Written approval by the A/E of each synopsis is required prior to beginning such training.
- C. For additional requirements for operating instructions, see respective Specification Sections.

1.07 MAINTENANCE MATERIALS

- A. Provide maintenance materials (tools, spare parts, extra stock, etc.) indicated in other sections of the specifications.
 - 1. Submit a receipt to the Owner identifying the product and quantity that is being provided.
 - 2. Obtain Owner's signature on the receipt.
 - 3. Send original receipt to E&AS Project Manager and include a copy of the receipt in the Warranties, Bonds, Extra Stock, and Permits manual.

1.08 SUBSTANTIAL COMPLETION

- A. Substantial Completion is defined in the General Conditions. Before requesting A/E's review for certification of Substantial Completion, complete the following, and provide a letter of request for Substantial Completion. List exceptions in the request.
 - 1. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Advise the Owner of pending insurance changeover requirements.
 - 3. Make final changeover of permanent locks and transmit keys, and a list identifying each key to the Owner. The list is a receipt to be signed by the Owner with a copy delivered to E&AS Project Manager and a copy placed in the Operation and Maintenance Manual hardware section. Advise the Owner's personnel of changeover in security provisions.
 - 4. Complete startup testing and commissioning of systems; submit Balancing Logs.
 - 5. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.
 - 6. Complete final clean-up requirements.
 - 7. Return all security badges and keys that were issued to the Contractor.
 - 8. Obtain occupancy permit from authority having jurisdiction.
 - 9. Submit final approved O&M Manuals, including warranty responsibility contract.
 - 10. Submit Certificates of Warranty.
 - 11. Submit Draft As-Built drawings for review.
 - 12. Turn over spare parts and materials to Owner.
 - 13. Turn over keys and key schedules to Owner.
 - 14. Submit a list of all paints used, manufacturer, and formulation for each.
 - 15. Submit evidence of completion of commissioning of designated building systems.
 - 16. Submit evidence of completion of Owner's training for all designated systems.
 - 17. Submit evidence of compliance with requirements of governing Authorities.

1.09 FINAL ACCEPTANCE

- A. Before requesting certification of Final Acceptance and final payment, complete the following. Submit all of the following items together – no partial submittals will be accepted.
 - 1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.

2. Submit an affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the work for which the Owner of property might in any way be responsible, have been paid or otherwise satisfied. (AIA Document G706).
3. Submit Contractor's Affidavit of Release of Liens (AIA Document G706A): If any liens are filed and cause the Owner to employ the services of any attorneys, the cost of the services will be deducted from the retainage.
4. Submit a letter from the Contractor's Bonding Company addressed to Owner and submitted to A/E approving release of final payment and waiving submittal of final receipts as well as a statement confirming the extension of the Bond for the one-year warranty period. Final receipts from all subcontractors and material and equipment suppliers shall be furnished to the A/E by the Contractor if the Surety does not waive this requirement.
5. Submit a copy of the A/E's final review list ("punch list") of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, identifying the name and company of the individual who confirmed completion of each item, and date when confirmation inspection was performed.
6. Submit consent of surety to final payment on AIA Form G707.
7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
8. Submit State Department of Labor and Industries Affidavit of Wages Paid (State Form 9843) approved by Department of Labor and Industries for all trades that have performed work on the Project.
9. Submit certified Statement indicating asbestos or lead containing material were not utilized or incorporated on the Project provided by Contractor under this contract.
10. Submit final As-Built Documents.
 - a. Others as required by Regulatory Agencies.
11. Submit all other required close-out documents.

1.10 REVIEW FEES

- A. The A/E and its consultants will complete one initial and one final project review of the Work at Substantial Completion and at Final Acceptance to establish and verify completion of punch list work. Should it be necessary for the A/E or its consultants to perform any additional reviews due to failure of Work to comply with completion status claimed by the Contractor, A/E and its consultants shall be compensated by the Contractor for each additional review required until the Work is satisfactorily completed. This compensation shall be at the A/E's and its consultants standard hourly billing rate at the time of the review, and expenses associated with the visit. Compensation by the Contractor will be through a deductive change order to the Contractor's contract.

END OF SECTION 01 77 00

SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.01 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.

1.02 SECTION INCLUDES

- A. Project Record Document submittal.
- B. Operation and Maintenance manuals.
- C. Warranties, Bonds, Extra Stock, and Permits manuals.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment. The following submittal procedure shall occur prior to Final Acceptance.
 - 1. Submit original copy of as-builts (drawings & specifications) to A/E for review.
 - 2. Compile and organize any drawings or schedules in the Project Manual onto sheets of the same size as the Contract Drawings and submit with other record documents.
 - 3. Contractor will be notified within 15 work days if the submitted documents are acceptable.
 - 4. Should the submittal be unacceptable for any reason, the Contractor shall make requested modifications and resubmit to the A/E. Continue to resubmit as necessary until the submittal is acceptable.
- B. Operation and Maintenance Data:
 - 1. Submit two (2) copies of preliminary Operating and Maintenance Manuals for operational and non-operational equipment for review by A/E. Submit for each system upon attaining 50% system completion, together with respective training synopsis; refer to Section 01 77 00. Upon review, A/E will return one copy with comments.
 - 2. Submit 1 copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with A/E comments. Revise content of all document sets as required prior to final submission.
 - 3. Within 10 days following receipt of the A/E approval and comments, and prior to Owner training, Contractor shall prepare and transmit to the A/E three (3) final copies of each of the above manuals.
- C. Warranties, Bonds, Extra Stock, and Permits:
 - 1. Obtain and assemble executed certificates, warranties, bonds, receipts for extra stock, permits signed by any authorities having jurisdiction, and any required service and maintenance contracts from the respective manufacturer's, suppliers, and Subcontractors. These may be tabbed in the front of the General Operation and Maintenance Manual provided they do not over-fill the binder(s).
 - 2. Verify that documents are in proper form, contain full information, and are notarized.
 - 3. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
 - 4. Co-execute submittals when required.

5. Submittal of warranties, bonds, extra stock and permit manual to match submittal requirements of Operation and Maintenance Manual.
6. Provide Table of Contents neatly typed, in complete and orderly sequence. Include complete information for each of the following:
 - a. Product or work item;
 - b. Firm, with name of principal, address, and telephone number;
 - c. Scope;
 - d. Date of beginning of warranty or service and maintenance contract;
 - e. Duration of warranty or service maintenance contract;
 - f. Proper procedure in case of failure;
 - g. Instances which might affect validity of warranty or bond; and
 - h. Contractor, name or responsible principal, address, and telephone number.
7. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
8. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
9. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing the date of acceptance as the beginning of the warranty period.
10. Furnish two (2) executed copies, except furnish three (3) additional confirmed copies required for inclusion into Operation & Maintenance manuals.

PART 2 - PRODUCTS

2.01 PROJECT RECORD DOCUMENTS

- A. Project Record Documents include the following:
1. Marked-up copies of Contract Drawings.
 2. Marked-up copies of Project Manuals (Specifications and Detail Book, as applicable), all volumes.
 3. Addenda.
 4. Reviewed and marked-up copies of shop drawings and product data.
 5. Newly prepared drawings.
 6. Change Orders, RFIs and other modifications to the Contract issued in printed form during construction.
 7. Architect's Clarifications and Proposal Request with all supporting documentation.
 8. Construction Change Directives.
 9. Record Samples.
 10. Field records for variable and concealed conditions.
 11. Record information on Work that is recorded only schematically.
 12. Manufacturer's instruction for assembly, installation, and adjusting.
 13. Other miscellaneous record documents as listed below as applicable.
 - a. Ambient and substrate condition tests.
 - b. Certifications received in lieu of labels on bulk products.
 - c. Inspections and certifications by governing authorities.
 - d. Final inspection and correction procedures.

PART 3 - EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintenance of Documents and Samples:

1. Store and maintain in field office apart from the Contract Documents used for construction, one complete set of record documents and samples which are used to record as-built conditions.
 2. Do not use Project Record Documents for construction purposes; protect from deterioration and loss in a secure fire-resistant location. Maintain record documents in good order and in a clean, dry, legible condition.
 3. Make record documents and samples available at all times for review by A/E and Owner's Representatives.
 4. Record actual revisions to the Work concurrent with construction progress.
 5. Ensure entries are complete and accurate, enabling future reference by Owner.
 - a. As specified in Section 01 31 19, following each monthly progress schedule meeting, Contractor shall meet with all major subcontractors whose work is in progress at the site, including but not limited to mechanical, plumbing, electrical, security, fire protection, civil, and as otherwise designated, to review all "as-built" revisions on the day-by-day working set of "Project Record Copy" and verify installed record information from the previous month is properly recorded on the day-by-day "Project Record Copy", with all revisions and pertinent information clearly indicated.
- B. Record Drawings and Shop Drawings: A clean, undamaged set of Contract Drawings including coordination drawings and shop drawings shall be kept at the job site as as-built record documents. Record "as-built" drawings shall be comprised of all sheets contained in the Contract Drawings, as well as all special equipment or systems drawings.
1. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawings that show conditions fully and accurately. Where shop drawings, RFI's or other communication record are used to identify a change, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Items required to be marked include, but are not limited to, the following:
 - a. Indicate field changes of dimension and detail.
 - b. RFIs.
 - c. Duct size and routing. Indicated locations of mechanical dampers, valves, reheat boxes, cleanouts, and other items that require maintenance.
 - d. Show measured locations of construction-concealed internal utilities and appurtenances referenced to visible and accessible features of the structure.
 - e. Record accurate locations of piping, valves, traps, dampers, duct work, equipment, and the like.
 - f. Revisions to electrical circuitry.
 - g. Indicate details not on original Contract drawings.
 - h. "X-out" conditions not constructed and appropriately annotate "not constructed" to convey the actual "as constructed" condition.
 2. Mark record sets in a clear, legible manner, using red ink (no pencils); use other colors to distinguish between variations in separate categories of the work. Use 'whiteout' to erase errors.
 3. Mark new information that is important to Owner, but which was not shown on Contract Documents or Shop Drawings.
 4. Show addenda items, change orders, RFI, or other means of communication used in the construction process.
 5. Show and date revisions to drawings with a "cloud" drawn around the revision.
 6. Organize record drawing sheets in manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set. Where shop drawings, RFI's or other communication record are used as a reference, include a copy of them as part of the record drawings.
- C. Shop Drawings
1. Maintain as record documents; legibly annotate to record changes made after review.

2. Include subcontractor reproducible shop drawings for all special equipment including as a minimum where applicable to the project, ductwork layout, fire sprinkler system layout, temperature control system, fire alarm system, intrusion alarm system, communications systems, data systems, detention security systems and others as deemed appropriate. Record Drawing shop drawings shall be easily reproducible; i.e., on mylar or of standard copy machine size, as appropriate and approved.
- D. Project Manual(s): During the construction period, maintain one complete copy of the Project Manual(s), including Specifications, Detail Book(s), addenda, and one copy of other written construction documents, such as Change Orders and RFI's issued in printed form during construction.
1. Legibly mark these documents in red ink to show substantial variations in actual work performed in comparison with the text of the specification and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and product data. Record at each product section description of actual products installed, including the following:
 - a. Manufacturer's name and product model and number.
 - b. Product substitutions or alternates utilized.
 - c. Changes made by Addenda and modifications.
 2. Mark Detail Book schedules, details, etc., to indicate the actual installation where the installation varies from that indicated in the Detail Book and modifications issued. Complete information in accordance with Paragraph 3.01C below for all detail drawings.
 3. Each prime contractor (Subcontractor) is responsible for marking up Sections that contain its own Work.
 - a. General Contractor shall be responsible for collecting marked-up record Sections from each of the other prime contractors. General Contractor shall also be responsible for collating these Sections in proper numeric order with its own Sections to form a complete set of record Specifications.
 - b. General Contractor shall be responsible for submitting the complete set of record Specifications as specified.
- E. Record Product Data
1. Maintain one copy of each product data submittal, and mark-up variations in actual work in comparison with submitted information. Include both variations in product as delivered to site, and variations from manufacturer's instructions and recommendations for installation.
 2. Give particular attention to concealed products and portions of the work which cannot otherwise be readily discerned at a later date by direct observation. Note related change orders and mark-up of record drawings and project manuals.
 3. Note related Change Orders and mark-up of record Drawings, where applicable.
 4. Upon completion of mark-up, submit complete set to Architect for Owner's records.
 5. Where record Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as record Product Data.
 6. Each prime contractor (Subcontractor) shall be responsible for marking up and submitting record Product Data for its own Work.
 7. Insofar as possible, insert record product data in individual sub-sections of O&M Manuals. Refer to 3.05 below.

- F. Record Sample Submittal: Immediately prior to date(s) of substantial completion, Architect (and including Owner's personnel where desired) will meet with Contractor at site, and will determine which (if any) of submitted samples maintained by Contractor during progress of the work are to be transmitted to Owner for record purposes. Comply with Architect's instructions for packaging, identification marking, and delivery to Owner's sample storage place.
- G. Miscellaneous Record Submittals: Refer to Paragraph 2.01A.13 above for listing of miscellaneous record documents and to other Sections of these specifications for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the work. Immediately prior to date of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to Architect for Owner's records.

3.02 OPERATION AND MAINTENANCE DATA - GENERAL

- A. General: For all operational equipment installed, Contractor shall submit operation and maintenance documents in manuals as specified herein. Separate sets of manuals shall be prepared for Divisions 21 through 25 and Divisions 26 through 28 equipment. For non-Division 21 through 28 equipment, the manuals shall contain both operational and non-operational items and equipment.
- B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. Content for Operational Equipment.
 - 1. Product Data.
 - a. Compile product data and related information for Owner's maintenance and operation. All manufacturer literature shall be original printed matter; photocopies, printouts from websites or other non-original reproductions are not acceptable.
 - b. Product data shall contain detailed information relative to the following:
 - 1) Description of unit or system, and component parts.
 - 2) Equipment functions, normal operating characteristics, and limiting conditions.
 - 3) Assembly, installation, alignment, adjustment and checking instructions.
 - 4) Operating instructions and sequences for start-up, break-in, routine and normal operation, regulation and control, shutdown, and emergency conditions. Include control diagrams and sequence of operation by controls manufacture; provide back-up disk of the sequence of operation of the DDC system.
 - 5) Routine procedures and guide for preventative maintenance and trouble shooting, including a schedule of recommended checks; disassembly, repair, and reassembly instructions.
 - 6) Detailed servicing and lubrication schedule. Include list of lubricants required.

- 7) Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - 8) Complete nomenclature and model number of replaceable parts. Include with list manufacturer's current prices and recommended quantities to be maintained in storage.
 - 9) Safety precautions and safety features.
 - 10) Outline, cross-section and assembly drawings, engineering data, and color coded wiring diagrams as installed.
 - 11) Test data and performance curves.
 - 12) Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
 - 13) Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
 - 14) Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - 15) Test and balancing reports.
- c. Include only sheet pertinent to specific product.
 - d. Annotate each sheet to:
 - 1) Clearly identify specific product or part installed.
 - 2) Clearly identify data applicable to installation.
 - e. Delete references to inapplicable information.
2. Drawings.
 - a. Supplement product data with drawings as necessary to clearly illustrate relations of component parts of equipment and systems.
 - b. Coordinate drawings with information in Project Record Documents to ensure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 3. Supplement product/installation data with written text.
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of installations for each procedure.
 4. Special Mechanical Subcontractor Requirements: Comply with Divisions 21 through 25 requirements.
 5. Special Electrical Subcontractor Requirements: Comply with Divisions 26 through 28 requirements.

3.04 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For all A/E non-operational products, applied materials and finish items installed, including but not limited to, floor coverings such as vinyl composition tile, acoustical ceiling panels, marker boards, etc., Contractor shall submit maintenance information as specified herein. Provide detailed information relative to the following:
 1. Manufacturer's data, giving full information on products.
 - a. Catalog number, size, and composition.
 - b. Color and texture designations.
 - c. Information required for re-ordering special manufactured products.
 2. Instructions for care and maintenance.
 - a. Manufacturer's recommendation for types of cleaning agents and methods.
 - b. Cautions against cleaning agents and methods, which are detrimental to the product.
 - c. Recommended schedule for cleaning and maintenance.
 - d. Instructions and recommendations for repair of finish.

3. Moisture protection and weather-exposed products.
 - a. Include product data listing applicable reference standards, chemical composition, and details of installation.
 - b. Provide recommendations for inspections, maintenance, and repair.
- B. For additional requirements for maintenance data, see respective Specification Sections.
- C. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.05 OPERATION AND MAINTENANCE MANUALS

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products. Prepare data in the form of an instructional manual.
- B. Format of Operation and Maintenance Manuals
 1. Binders
 - a. Commercial quality, stiff cover, metal-hinged 8-1/2 x 11 inch three D side ring binders with durable and cleanable plastic covers. Binders shall be Wilson Jones #344 Series or equivalent as approved by the A/E.
 - b. Provide suitable ring size for content with a 1-inch minimum, up to 3-inch maximum, range.
 - c. When multiple binders are used, correlate data into related consistent groupings.
 2. Cover and Spine: Identify the cover and spine of each volume with typed or printed title of the project, project number, and the words OPERATION AND MAINTENANCE INSTRUCTIONS.
 3. For Contractor produced pages, paper shall be 8-1/2" x 11", white, 20 pound minimum.
 4. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
 5. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
 6. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
 7. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
 8. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - a. Part 1: Directory, listing names, addresses, and telephone numbers of A/E, A/E Consultants, Contractor, Subcontractors, and major equipment suppliers.
 - b. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - 1) Significant design criteria.
 - 2) List of equipment.
 - 3) Parts list for each component.
 - 4) Operating instructions.
 - 5) Maintenance instructions for equipment and systems.
 - 6) Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - c. Part 3: Project documents and certificates, including the following:
 - 1) Shop drawings and manufacturer's printed product data.
 - 2) Air and water balance reports.
 - 3) Certificates.
 - 4) Photocopies of warranties and bonds.

- 5) Materials Safety Data Sheets (MSDS) for each product used on the Project.
9. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
10. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

3.06 WARRANTIES, BONDS, AND PERMIT MANUAL

A. Project Warranty – General:

1. If, within one (1) year after the Date of Substantial Completion of the Work, or designated portion thereof, or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be defective or not in accordance with the Contract Documents, the Contractor, and where applicable, his subcontractor that portion of the work, shall correct it promptly after receipt of a written notice from the Owner or Architect to do so. This obligation shall survive Termination of the Contract. The Owner will give such notice promptly after discovery of the condition.

B. Categories Of Specific Warranties

1. Warranties on the work are in several categories, including those of General Conditions, and including (but not necessarily limited to) the following specific categories related to individual units of work specified in Sections of Divisions 02 through 28 of these specifications.
 - a. Special Project Warranty (Guarantee): A warranty specifically written and signed by Contractor for a defined portion of the work; and, where required, countersigned by subcontractor, installer, manufacturer or other entity engaged by Contractor.
 - b. Specified Product Warranty: A warranty which is required by contract documents, to be provided for a manufactured product incorporated into the work; regardless of whether manufacturer has published warranty without regard for specific incorporation of product into the work, or has written and executed warranty as a direct result of contract document requirements.
 - c. Coincidental Product Warranty: A warranty which is not specifically required by contract documents (other than as specified in this section); but which is available on a product incorporated into the work, by virtue of the fact that manufacturer of product has published warranty in connection with purchases and uses of product without regard for specific applications except as otherwise limited by terms of warranty.
2. Refer to individual sections of Divisions 02 through 28 for the determination of units of work which are required to be specifically or individually warranted, and for the specific requirements and terms of those warranties (or guarantees).

- #### C. Disclaimer and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

D. General Limitations

1. It is recognized that specific warranties are intended primarily to protect Owner against failure of the work to perform as required, and against deficient, defective and faulty materials and workmanship, regardless of sources.
2. Except as otherwise indicated, specific warranties do not cover failures in the work which result from: 1) Unusual and abnormal phenomena of the elements, 2) The Owner's misuse, maltreatment or improper maintenance of the work, 3) Vandalism after time of substantial completion, or 4) Insurrection or acts of aggression including war.

- E. Related Damages & Losses
1. General: In connection with Contractor's correction of warranted work which has failed, remove and replace other work of project which has been damaged as a result of such failure, or must be removed and replaced to provide access for correction of warranted work.
 2. Consequential Damages: Except as otherwise indicated or required by governing regulations, special project warranties and product warranties are not extended to cover damage to building contents (other than work of Contract) which occurs as a result of failure of warranted work.
- F. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- G. Reinstatement Of Warranty Period: Except as otherwise indicated, when work covered by a special project warranty or product warranty has failed and has been corrected by replacement or restoration, reinstate warranty by written endorsement for the time period starting on the date of acceptance of replaced or restored work and ending upon date original warranty would have expired if there had been no failure, with an equitable adjustment for depreciation.
- H. Replacement Cost, Obligations: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. Contractor shall be responsible for the cost of replacing or restoring defective Work regardless of whether the Owner has benefited from use of the Work through a portion of anticipated useful service life.
- I. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, right, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- J. Rejection Of Warranties: Owner reserves the right, at time of final acceptance or thereafter, to reject coincidental product warranties submitted by the Contractor, which in opinion of Owner tend to detract from or confuse interpretation of requirements of Contract Documents.
- K. Contractor's Procurement Obligations: Do not purchase, subcontract for, or allow others to purchase or sub-subcontract for materials or units of work for project where a special project warranty, specified product warranty, certification or similar commitment is required, until it has been determined that entities required to countersign such commitments are willing to do so.
- L. Co-execute warranties when required. Provide originals of each for inclusion in each operation and maintenance manual.
- M. Retain warranties and bonds until time specified for submittal.
- N. SPECIFIC WARRANTY FORMS
1. Where a special project warranty (guarantee) or specified product warranty is required, prepare a written document to contain terms and appropriate identification, ready for execution by required parties.
 2. Submit draft to Owner (through Architect) for approval prior to final executions.

3. Form of Warranty to state the following:

I (We), (insert Contractor name), certify (insert name of trade or portion of work being guaranteed) installed by (insert name of appropriate subcontractor) on (insert the name of the project and project number) located in Olympia, WA, is performed in strict accordance with Contract Documents. Further, I (we) guarantee this work to be (watertight, without lead, other, etc.) caused by defects in materials and workmanship, for (fill in specific required guarantee period) years from (date of substantial completion), and will repair, or replace, without delay, any defects in materials and workmanship discovered within warranty period.

Sincerely,

(Name of Contractor/responsible principal/address/telephone number)
Signed by Owner, Partner, or other person authorized to commit firm.

END OF SECTION 01 78 00

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 TRAINING REQUIREMENTS

- A. Instruct the Owner's representatives in all aspects of the operations of systems and equipment.
- B. Provide training to cover operation of the building DDC system and the software procedures to allow the Owner's personnel to add, modify, or create points, DDC loops, graphics or energy management programs. The instruction shall consist of hands-on and training at the project site. Training shall include a "Question Period" at the close of each session.
- C. Prior to providing instructions to Owner's representatives, provide final version of the Operating and Maintenance Manuals in three ring binders with index tabs, each containing all Subcontractor's and suppliers' names and telephone numbers, data sheets, valve charts, equipment charts if changes to equipment are made, brochures, operating, maintenance and lubricating instructions as well as number coded wiring diagrams and a complete set of reviewed Shop Drawings. Present all copies to the Owner for review in ample time for use during the instructions to Owner.
- D. Supply tools, spare parts, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- E. Manufacturers shall provide demonstrations and instructions on all equipment and materials.
- F. Use final version of Operating and Maintenance Manual, "as-built" drawings, audio visual aids, etc. as part of instructional materials. Owner's training shall not start until these documents are completed and shall be completed just prior to the Certificate of Total Completion being granted.
- G. Contractor commissioning and assistance provided to the Owner during the trial usage period shall not count as training time.
- H. Commissioning and time spent with Contractor's staff by Owner's personnel shall not substitute for nor count as training. Owner's staff shall be allowed to participate in the commissioning process.
- I. Obtain Owner's acceptance of instruction in writing after instructions to Owner is completed.

1.02 INSTRUCTOR QUALIFICATIONS

- A. The Contractor shall provide competent technicians who shall give full instruction to the Owner's designated personnel in the adjustment, operation and maintenance, including pertinent safety requirements of the equipment and systems specified, with emphasis on:
 - 1. How to use and find information in documentation
 - 2. System operational procedures for all modes of operation including: warm-up, cool-down, emergency, seasonal change-over, occupied, unoccupied, etc.

3. Acceptable tolerances for system adjustment in all operating modes
 4. Procedures for dealing with abnormal conditions and emergency situations for which there is a specified system response
 5. Troubleshooting procedures to deal with equipment malfunction or failure
- B. Arrange and pay for services of Manufacturers' representatives required for instruction on specialized portions of the installation, maintenance and/or operation.
- C. A/E shall have the right to approve or reject the instructors based on their qualifications.
- D. Contractor shall permit the Owner to videotape the training sessions for the Owner's internal use such as training new employees.

1.03 TRIAL USAGE AND TESTS

- A. The Owner shall have the privilege of trial usage of mechanical systems or parts thereof for the purpose of testing and learning operational procedures prior to acceptance.
- B. Contractor shall assist in trial usage for a period of time, as deemed reasonable by the Owner. Supply labor, material and instruments at no extra cost. Contractor shall not waive any responsibility because of trial usage. Assistance provided by the Contractor during the trial usage period shall not be counted as training time specified elsewhere in the Specification.
- C. Trial usage by the Owner shall not be construed as acceptance of the Work by the A/E.
- D. Provide the highest level password for DDC system from Owner to permit this trial usage to occur.
- E. Provide and pay for all testing required on the system components where, in the opinion of the A/E, Manufacturer's ratings or specified performance are not being achieved.

END OF SECTION 01 79 00

SECTION 01 91 00

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. The Owner will employ an independent Commissioning Authority (CxA). The CxA is an independent and knowledgeable third party, hired to verify that the systems work as intended. The CxA will inform the Owner and the Architect of the results of commissioning and provide recommendations for final acceptance of commissioned systems.
- B. Commissioning is the process to verify to the Owner that mechanical and electrical systems, as well as other special systems, function together properly to meet the facility performance requirements and design intent as described in the Contract Documents. The Contractor shall be responsible for participation in the commissioning process as outlined below, and in references and attachments throughout the Contract Documents. The Contractor shall furnish labor and materials sufficient to meet all requirements of building commissioning under this contract.
- C. The CxA, acting on the behalf of the Owner, will be cognizant of the Owner's Facilities Staff's need to be informed and given the opportunity to participate actively in the commissioning process to ensure a complete, thorough turnover of systems once the project is complete. To this end, the CxA will ensure that Facilities Personnel are informed of commissioning activity and schedule, and of any coordination issues, such as special testing procedures or opportunity for hands-on training during functional testing.
- D. The CxA is not authorized to modify, add to, or revoke the requirements of the Contract Documents. A change in the work can only be made as provided in the General Conditions.
- E. Specification sections in Division 1 - General Requirements (019100); Division 23 - Heating, Ventilating, and Air Conditioning (230800 - Cx of HVAC); and Division 26 - Electrical (260800 - Cx of Electrical); outlines the specific commissioning responsibilities of each subcontractor for that division, and also obligates the Contractor to coordinate and manage the commissioning responsibilities of those subcontractors.

1.2 RELATED WORK

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to the work of this section.
- B. General requirements for testing agencies as specified in the Division 1, "Section Quality Control Services."
- C. Applicable Division 23 section identifying the requirements for HVAC systems relating to the installation of mechanical equipment and systems, particularly with respect to equipment and system testing, start-up and performance demonstration/observation. Coordinate with the work of Division 26.
- D. Applicable Division 26 sections specifying the requirements for materials and installation of electrical equipment and systems, particularly with respect to equipment and system testing,

start-up, arc flash and selective coordination and performance demonstration/observation. Coordinate with the work of Divisions 22 and 23.

1.3 TERMS

- A. **Acceptable Performance:** A component or system being able to meet specified design parameters under actual load, including satisfactory documented completion of all functional performance tests, control system trending, and resolution of outstanding issues.
- B. **CxA:** An independent and knowledgeable third party hired to verify that the systems achieve acceptable performance.
- C. **Commissioning Field Notebook:** An online hosted webpage providing system readiness checklists and the commissioning plan. Start-up documents can be uploaded to the matrix providing a complete 'notebook' to be used in the field by the Commissioning Team.
- D. **Commissioning Plan:** The Commissioning Plan is prepared by the Owner's CxA and defines the scope and format of the commissioning process and the responsibilities of all involved parties. The Commissioning Plan is provided to all commissioning team members to inform them of the intent and scope of the commissioning work to ensure inclusion in the project scope and to expedite the commissioning process.
- E. **Commissioning Team:** The term used to define the overall group associated with performing commissioning work, including designated representatives of the Owner, Facilities Staff, A/E Design Team, Construction Team, and the CxA.
- F. **Construction Team:** The term used to define the overall group responsible for performing the work to complete the work on the Contract Documents, including the Construction Manager, Contractor, the Mechanical Contractor and associated subcontractors, and the Electrical Contractor and associated subcontractors.
- G. **Controls Summit:** A meeting or meetings that occurs early after project award to coordinate and finalize the understanding of how the engineer of record sequence of operations is to be implemented before finalizing the control contractor's hardware and software shop drawings, graphics and other related submittals.
- H. **Design Intent:** Documentation behind design decisions that were made to meet the Owner's project requirements. The design intent describes the systems, components, conditions and methods to provide a fully functioning building.
- I. **Functional Performance Testing:** Full range of checks, tests and demonstrations carried out to determine that all components, sub-systems, systems, and interfaces between the systems function in accordance with the Contract Documents. In this context, function includes all modes and sequences of control operation, all interlocks and conditional control responses, and all specified responses to abnormal emergency conditions.
- J. **Issue Resolution Log (IRL):** The purpose of this log is to provide a method for tracking and resolution of items discovered as a result of the commissioning process. This list also includes the current disposition of issues and the date of final resolution as confirmed by the CxA.
- K. **International Energy Conservation Code (IECC):** Comprehensive energy conservation code establishes minimum regulations for energy-efficient buildings using prescriptive and performance-related provisions.

- L. Owner Project Requirements (OPR): A document developed by the Owner, with help of the CxA and A/E Design Team. The OPR details the functional requirements of the project, and the expectations of the buildings use and operation as it relates to the systems being commissioned.
- M. Performance Period: A period of time following the completion of Functional Performance Testing with minimal involvement/intervention from the installing contractor(s) where the performance of the Commissioned Systems are monitored and tracked for any deviations from expected outcomes. A Performance Period may also sometimes be referred to as a "trending period."

1.4 DUTIES OF CONTRACTOR

- A. It is the responsibility of the Construction Manager or General Contractor to assure that all requirements of this specification section are completed by the CM/GC and their sub-contractors.
- B. Provide vendor information to the CxA as requested enhancing the CxA's understanding of contractor and vendor obligations and responsibilities, and as needed to benefit the commissioning effort.
- C. Provide electronic copies of all submittals, shop drawings, coordination drawings, manufacturer's literature, maintenance information or other information as may be needed for systems to be commissioned to the CxA.
- D. Submit all manufacturer's installation inspection and start-up procedures (i.e., pre-functional test procedures) for review by the CxA.
- E. Incorporate commissioning activities into the overall construction schedule.
- F. Coordinate participation of the Mechanical, Electrical, Controls, Security, Fire Alarm and TAB Contractors in the commissioning process.
- G. Collect and provide to the CxA information requested for development of a complete commissioning plan, Installation Completion Matrix, and functional test procedures.
- H. Review the commissioning plan, project communication reports and test results, and submit comments to the CxA.
- I. Coordinate participation in the Controls Summit. Manage, track and complete the Commissioning Field Notebook, including Installation Completion Matrix and commissioning related specification requirements.
- J. Provide to the CxA the controls system complete point listing that includes a summary of all points; full description; point naming, address, type and units, including mapped points from third party equipment controls; and calculated or virtual points. This information shall be in Excel or .csv format.
- K. Verify that coordination, installation, quality control, and final testing have been completed such that installed systems and equipment comply with construction documents.
- L. Provide CxA with controls system wiring diagrams and narrative sequences of operation in time for use in preparing the functional test procedures.
- M. Participate in any efforts to finalize sequences of operations with Owner, A/E Design Team, and CxA.

- N. In a timely manner, address issues identified during construction that may affect the commissioning process or final system performance.
- O. Participate in commissioning meetings with the CxA.
- P. Ensure the building automation system graphics are submitted for approval by the A/E prior to testing and these graphics are operational prior to the start of functional testing.
- Q. Provide preliminary TAB report, indicating all actual field values recorded, to the CxA prior to initiation of functional testing. These reports may be hand written and shall be incorporated in the Commissioning Field Notebook.
- R. Provide a fully operational system per the contract documents, started, verified, debugged, calibrated, balanced, tested and under automatic control prior to providing written notice via the commissioning readiness sign-off sheet for inclusion in the commissioning field workbook.
- S. Issue a written notice of Cx readiness for each system to CxA upon completion via completed and signed readiness checklist, installation completion matrix or pre-functional checklist. Functional testing will not begin for any system until signed notice of Cx readiness is issued.
- T. Provide proprietary test equipment required to test all the systems and equipment in this project.
- U. Operate equipment and systems, as required, for functional performance testing. This includes, but is not limited to, manipulating the appropriate controls systems to achieve the expected response for the functional test procedure and initiating HVAC system fire alarm interactions via the fire alarm system.
- V. Participate in the fine-tuning or troubleshooting of system performance if either becomes necessary.
- W. Submit complete operation and maintenance information, and as-built drawings in accordance with contract documents to the CxA for review.
- X. Provide documentation of training for the systems specified.
- Y. Compensation for the CxA for retesting and/or troubleshooting time will be requested to the Owner from the CxA if the Contractor's systems do not meet specified performance. Contractor will be required to reimburse Owner for this additional expense.

1.5 DUTIES OF COMMISSIONING AUTHORITY (CxA)

- A. Provide Contractor with expected durations of commissioning activities for inclusion in the construction schedule.
- B. Collect and review design intent from the A/E Design Team.
- C. Review the Contract Documents.
- D. Develop the commissioning plan.
- E. Develop commissioning specifications for inclusion in the contract documents.
- F. Develop start-up matrix for each piece of commissioned equipment.

- G. Develop the Commissioning Field Notebook for use by the Contractor. Provide supplemental documentation, as necessary, to ensure that all aspects of start-up and testing have been complete and documented prior to functional testing.
- H. Organize a commissioning kickoff meeting and present the commissioning plan to the Commissioning Team.
- I. Review the Contractor submittals relative to the systems to be commissioned.
- J. Conduct a Controls Summit meeting with the Owner, Architect, Contractor and Building Automatic Temperature Control (ATC) Contractor.
- K. Review construction installation progress and verify system installation quality and readiness for testing.
- L. Observe the start-up activities and initial testing of equipment and systems, as required, and review Contractor start-up documentation.
- M. Develop functional test procedures from Contractor submittals, including designer-approved control documentation, and narrative sequences of operation and control diagrams.
- N. Direct and perform and document functional testing with assistance from Contractor.
- O. Provide site observation, functional test and other project reports in a timely manner. Document inconsistencies or deficiencies in system operations and system compliance.
- P. Coordinate participation of Owner's Personnel involved with equipment, component and systems performance verification, and participation in required training.
- Q. Witness and verify satisfactory completion of equipment and component tests and systems and inter-systems functional performance tests.
- R. Verify resolution of issues identified through the commissioning process. Contractor to provide updates within the web-based Issue Resolution Log.
- S. Verify training for commissioned equipment and systems is provided to the Owner.
- T. Review Contractor Operations & Maintenance Manuals for commissioned equipment and systems.
- U. Complete a commissioning report.

1.6 ADDITIONAL DUTIES OF THE TAB CONTRACTOR

- A. Provide as-built TAB one-line documentation for all balanced systems. Hydronic systems shall include risers and main branch take-offs complete with pipe size and balanced flow. Airside systems shall include duct risers and main branch take-offs with duct size, balanced flow and pressure and full flow conditions.
- B. Provide static pressure profiles for all air handling equipment while same is operating at design capacity specifically noting equipment components and airflow volumes.
- C. Conduct air flow station calibration verification in the presence of the CxA, and document results in TAB report.

- D. Re-measure air and water flows as directed by the CxA to verify proper TAB measurement procedures were followed, and the results are repeatable. If 10% or more of the spaces spot-checked do not match reported airflows, additional spot checking will be conducted at the expense of the TAB contractor.
- E. Measure building pressure during peak heating season with all air handlers controlling to minimum outside air flow.
- F. Measure building pressure during peak cooling season with all air handlers controlling to minimum outside air flow.
- G. Measure building pressure under 100% outside air economizer conditions {if applicable} with all air handler fans operating under normal BAS control.
- H. Observe duct pressure testing.
- I. Perform site observations of all air and hydronic systems for access to all balancing devices (i.e. manual volume dampers and hydronic balance devices) prior to installation, system fill and insulation.

1.7 ADDITIONAL DUTIES OF THE BUILDING AUTOMATION TEMPERATURE CONTROL CONTRACTOR

- A. Coordination of final sequence of operations with the Owner, A/E and CxA prior to submittal. Testing and start-up of the equipment including completed control systems, point-to-point verification of all system inputs and outputs, calibration checks and accurate system graphics.
- B. Providing qualified personnel for participation in commissioning tests, including seasonal testing required after the initial commissioning.
- C. Provide test holes in ducts and plenums where directed or necessary for sensor calibration verification. Test holes shall be provided with an approved removable plug or seal. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.
- D. Provide test connection ports for airside differential pressure switches and transmitters.
- E. Provide test connection ports for waterside differential pressure transmitters.
- F. Provide all devices, software, cables and devices necessary to communicate with controllers, so that commissioning can proceed in an efficient manner.
- G. All commissioning activities will utilize the graphics on the building automation system workstation. This contractor shall be responsible for submitting graphics for review by the A/E prior to commencement of field testing. Commissioning testing will not begin until graphics are A/E approved and fully functional.
- H. Provide remote access to the automation system for the CxA.
- I. Provide a dedicated site license, access to the programming and graphics tools for the building automation system front-end workstation for use by the CxA prior to downloading controls programming. The CxA shall review all completed controls programming against the approved sequences of operation. The CxA will communicate directly with the ATC Contractor by noting all comments in the programming tool. Any deficiencies identified will be recorded to the IRL report.

- J. Provide 2-way radios, as necessary, for coordination during field testing with the CxA.
- K. Providing training to the CxA on basic operation of the control system along with appropriate personal access for commissioning.
- L. Fulfill contract and warranty requirements by providing equipment, software, software programming materials and labor necessary to correct deficiencies found during the commissioning process.
- M. After completion of Cx activities but before Owner occupancy, set up and provide interval trends for duration of Performance Period for all points required by the CxA. The list of points and frequency required will be developed as part of the Commissioning Plan. Provide this data in a Microsoft Excel compatible format.
- N. Provide sequences of operation in a MS Word compatible format.
- O. Provide as-built control diagrams in individual PDF format on a per system basis.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Standard test equipment for commissioning will be provided by the CxA.
- B. Division 21, 22, 23 and 26 Contractors shall provide standard and specialized test equipment as necessary to test and start up the systems.
- C. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the installing contractor. Manufacturer shall provide the test equipment, demonstrate its use and assist the CxA in the commissioning process.
- D. The Contractor shall provide all equipment, software and all test programming support as necessary to start up, calibrate, debug and verify proper function of the control/facility management system. This equipment and software shall be provided for use by both the test and balance contractor and the CxA.

2.2 BUILDING AUTOMATION SYSTEM TEST EQUIPMENT

- A. This ATC Contractor shall provide all equipment, software and all test programming support as necessary to start up, calibrate, debug and verify proper function of the control/building management system. This equipment and software shall be provided for use by both the test and balance Contractor and the CxA at no additional charge to the project.
- B. Proprietary test equipment, including hardware, software and specialized test instruments, required by the manufacturer for system testing and commissioning, whether specified or not, shall be provided by the control system contractor at no additional charge to the project. This Contractor shall provide the test equipment, demonstrate its use and assist the CxA in the commissioning process. This includes, but is not limited to, provision of any proprietary software required for communication with terminal equipment controllers and access to graphical user interfaces.
- C. ATC Contractor shall provide remote access to the Building Automation System (BAS) to the CxA.

- D. The contractor shall provide a site license dedicated to the CxA during field testing at no additional charge to the project.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS

A. Commissioning Schedule

1. Contractor to incorporate commissioning activities into the overall construction schedule. If construction is phased, commissioning activities are to be included in all phases of the schedule. The schedule defines the milestones and conditions that must be achieved before functional testing can commence. The schedule also includes the expected duration of the various tasks. The CxA will provide the Contractor with expected durations of commissioning activities.
2. Special consideration shall be given to the schedule to prevent unrealistic overlap of activities within the same area of the building with each other and with commissioning (e.g., air and water balancing, enabling return air without floor level cleanliness, flooring installation, and fire alarm testing).
3. Contractor to develop a systematic start-up / close-out / commissioning schedule or include the same information in the overall construction schedule. For each of the equipment/systems, the following activities shall be indicated on the Startup and Commissioning Schedule as a minimum (note that not all of these activities apply to all equipment/systems and that some equipment/systems will require additional activities and prerequisites to be indicated):
 - a. Equipment Installation Completion Date(s) with referenced prerequisites from the General Schedule,
 - b. Permanent Power Completion Date(s), including power connection to equipment,
 - c. Availability of central plant services (i.e. chilled water, hot water, steam)
 - d. Controls Wiring Completion Date(s)
 - e. Manufacturer's Representatives' Equipment/System Startup Date(s)
 - f. Contractors' Equipment/System Startup Date(s)
 - g. BAS Point to Point Testing Date(s)
 - h. Test and Balancing Date(s)
 - i. 3rd-Party Electrical Testing Agency Testing Date(s)
 - j. Floor level final clean and dust free
 - k. Fire Alarm System Pre-Testing Date(s),
 - l. Fire Department Fire Alarm and Fire Suppression Systems Testing Date(s),
 - m. Functional Performance Testing Date(s)
 - n. Substantial Completion Date(s)
 - o. Owner Move in Date(s)
 - p. Operations and Maintenance Manual review.
 - q. Owner personnel training.

B. Contract Document Review

1. The CxA will collect and review design intent information from the design team and verify that it meets the Owner's project requirements. Design intent documentation will be used in conjunction with the Contract Documents to develop the commissioning plan, pre-functional tests, and functional performance tests.

C. Commissioning Plan

1. The CxA will develop a commissioning plan for the project. The commissioning plan is a tool through which the commissioning process is described and incorporates the Owner, A/E Design Team, Contractor and CxA's roles relative to the commissioning process. The commissioning plan will include the following:
 2. Elements of the Plan
 - a. Detail the commissioning process
 - b. Identify commissioning team members
 - c. Include a commissioning team organization chart
 - d. Define commissioning team member responsibilities
 - e. Describe pre-functional and functional test procedures
 - f. Outline systems to be commissioned
 - g. Provide a list of Commissioning Activities, including durations
- D. Equipment Matrix
1. The CxA will develop an equipment matrix for each piece of commissioned equipment and review contractor provided startup checklists. The pmatrix will outline required steps for the Contractor to complete prior to functional testing. The matrix will verify installation, start-up and operational assessments have been completed for the equipment.
 2. Manufacturer start-up forms provided with pieces of equipment will be collected in addition to the completed matrix.
- E. Commissioning Field Notebook (hosted online)
1. The CxA will develop a Commissioning Field Notebook to be used and completed by the Contractor. The notebook will identify and track all pertinent commissioning documentation required during the installation, start-up, and checkout phases. The notebook will be maintained by the Contractor and will be made available to all Subcontractors for their use. The notebook provides a central location for the Subcontractors and CxA to identify, copy, and organize all pertinent commissioning information.
 2. The Commissioning Field Notebook will contain:
 - a. Summary describing the notebook's contents and use
 - b. Commissioning plan for Contractor field reference
 - c. Equipment Matrix
- F. Commissioning Kickoff Meeting
1. The commissioning plan will be presented to the Commissioning Team during a commissioning kickoff meeting. The Commissioning Team will review the plan and provide comments to the CxA. The CxA will incorporate appropriate comments into the plan and a finalized commissioning plan will be distributed to the Commissioning Team.
 2. The Commissioning Field Notebook will be presented to the Contractor during the commissioning kickoff meeting. Instruction for its use will be conveyed during the meeting.
- G. Installation Progress Review
1. During the course of construction, the CxA will perform installation reviews for commissioned equipment and systems. Deficiencies and/or recommendations will be noted and conveyed in project communication reports to the appropriate Commissioning Team members.
- H. Equipment Matrix Completion

1. Using the equipment matrix developed or approved by the CxA, the Contractor will verify that the systems they install are in compliance with the construction documents and are fully functional. Functional testing will only begin when checklists are completed by the appropriate subcontractors, initialed, signed, and returned to the CxA indicating specific system completion.
 2. Contractor will issue a written notice of readiness to the CxA upon completion of all systems work, start-up and endorsement of pre-functional tests.
- I. Contractor Submittal Review
1. The Contractor will provide electronic copies of the submittals for commissioned systems and equipment to the CxA for use in development of functional test procedures.
 2. The CxA will review submittals for conformity with the design intent.
- J. Functional Test Procedures
1. The CxA will develop functional test procedures for each piece of commissioned equipment. The functional tests outline the process for testing the building's systems. Functional tests verify the performance of equipment adhere to the design intent.
 2. Functional test procedures include, but are not limited to, the following:
 - a. Verification of testing, adjusting and balancing performance
 - b. Verification of the performance of automatic controls in all seasonal modes
 - c. Verification of the performance of a HVAC system
 - d. Verification of the performance of electrical systems
 - e. Verification of the performance of all life safety interactions with the HVAC systems
- K. Functional Testing
1. Functional testing is intended to begin upon completion of a system. The CxA will not begin the functional testing process until each system is complete and documented. Testing may proceed prior to the completion of systems and/or sub-systems if expediting this work is in the best interests of the Owner.
 2. Functional testing is performed by the Contractor and witnessed by the CxA to verify proper sequencing, operation, and performance of installed equipment and systems under realistic operating conditions. As tests are successfully completed, systems will be deemed acceptable by the CxA.
 3. The Contractor is responsible for coordinating participation of CxA and Subcontractors in functional testing.
 4. For security, fire alarm, theater sound and theater lighting systems, the installing contractor will be responsible for providing point-to-point documentation and functional test documentation. The CxA will witness testing of these systems.
- L. Issue Resolution Log
1. When acceptable performance cannot be achieved by tested equipment and systems, the cause of the deficiency will be identified. Deficiencies will be collected and tracked in an Issue Resolution Log maintained by the CxA.
- M. Corrective Measures
1. If acceptable performance cannot be achieved by a piece of equipment or a system, and if the deficiency is caused by installation error by the Contractor, the necessary corrective measures shall be carried out by the Contractor. Once corrective measures have been

completed, the equipment or system will be retested by the CxA until acceptable performance is achieved.

2. A 16-hour retest allowance is included in the commissioning scope for repeats of failed tests. If retesting to achieve acceptable performance exceeds this allowance, the Contractor shall be financially responsible at standard rates to reimburse the CxA for the additional time and travel costs required to resolve deficiencies.

N. Project Communication Reports

1. In addition to the start-up matrix, functional test procedures and the Issue Resolution Log, project communication reports will be provided to document all other commissioning activities performed by the CxA. Project communication reports will be issued to the Contractor and key members of the Commissioning Team to document apparent deficiencies identified during examination of design and construction documents, daily activities on-site, installation deficiencies, and successful or unsuccessful functional testing results.

O. Commissioning Meetings

1. Commissioning meetings will be held periodically during the construction process to review the status of the construction and commissioning work, develop construction completion and testing schedules, and the status of submittals required by this section. Attendance by the Construction Team is required for commissioning meetings.
2. Commissioning meetings will be coordinated by the Contractor. Meeting minutes will be developed and maintained by the CxA.

P. Operations and Maintenance Manual Review

1. The Contractor shall assemble Operations & Maintenance Manuals as described in other sections of these Contract Documents.
2. Documentation shall be submitted electronically. Scanned copies are not acceptable.
3. The CxA will review the Operations & Maintenance Manuals of commissioned systems and equipment after they have been reviewed and accepted by the A/E Design Team.

Q. Training

1. A training plan will be developed by the Contractor outlining equipment that requires training, who will perform the training, when the training will occur, and the required duration of the training. Once the training plan is developed, the Owner will review and approve training durations and quantities proposed by the Contractors and coordinate the training schedule with the construction team to ensure that the appropriate personnel attend the training.
2. Training sessions should include using the Operations & Maintenance Manuals and as-built drawings assembled by the Contractor.
3. Detailed requirements for training and instruction are contained in other sections of these Contract Documents.
4. Contractor to provide a copy of all Owner Training documentation to the CxA for review.
5. The CxA will track that training requirements have been satisfied by the Contractor.

R. Commissioning Report

1. Once acceptable performance is achieved, the CxA will complete a commissioning report. The report shall include:

- a. A commissioning activity executive summary.
 - b. The finalized commissioning plan.
 - c. The completed Commissioning Field Notebook, including pre-functional test checklists and specified commissioning related documentation.
 - d. Completed functional test procedures.
 - e. Commissioning project communication reports.
 - f. Up-to-date Issue Resolution Log.
- S. Post Occupancy
1. CxA shall verify opposite season operation of systems using trend review or MBCx program.
 2. CxA shall interview Owner's operations staff and compile a list of observed issues for resolution by the contractors prior to the end of the warranty period.

3.2 SYSTEMS TO BE COMMISSIONED

1. Systems and equipment to be functionally tested include, Heating water system, Air supply, exhaust, relief and ventilation system, Terminal cooling and heating system, Automated control systems and lighting controls as described in Division 1 (01 91 00), Division 23 (23 08 00) and Division 26 (26 08 00).

END OF SECTION 01 91 00

SECTION 02 41 19

SELECTIVE DEMOLITION

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. This Section includes the following:
 - 1. Demolition and removal of selected building elements.

1.3 DEFINITIONS

- A. Demolish: Completely remove and legally dispose of off-site.
- B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.
- C. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- D. Remove and Salvage: Detach items from existing construction and deliver them to Owner.
- E. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- F. Existing to Remain: Existing facilities, utilities, or other improvements to be protected and that are not otherwise indicated to be recycled, removed, removed and salvaged, or removed and reinstalled.
- G. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- H. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1. Coordinate with Owner, who will establish procedures for removal and salvage.

1.5 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241.
- D. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- E. 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.
- F. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.6 PROJECT CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.
 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 – PRODUCTS (Not used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Field verify existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. If unanticipated elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and systems serving areas to be selectively demolished.
 - 1. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building and existing facilities.
 - 2. Cut off pipe or conduit to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

- A. 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.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent portions of the building to remain.

1. Provide protection to ensure safe passage of people around selective demolition area.
 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 existing construction to remain.
 3. Protect existing facilities, utilities, and other improvements that are to remain or that are exposed during selective demolition operations.
- C. Temporary Shoring: 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.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the 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, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 2. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations. Fire watch duration shall conform with regulations of the governing fire department.
 4. Maintain adequate ventilation when using cutting torches.
 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 6. Dispose of demolished items and materials promptly.
 7. Proceed with patching after construction operations requiring cutting are complete.
- B. 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 during selective demolition and reinstalled in their original locations after selective demolition operations are complete.
- C. 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 possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate 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. Restore damaged pipe covering to its original condition.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 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.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 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 02 41 19

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SECTION 03 54 16
CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hydraulic-cement-based, polymer-modified, self-leveling underlayment for application below interior floor coverings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

PART 2 - PRODUCTS

2.1 UNDERLAYMENTS

- A. Cement Underlayment: Single component, portland-cement-based, polymer-modified, trowelable structural repair material that can be applied in minimum uniform thickness of 1/4-inch and extended up to 3-inches.

1. Ardex; ERM Underlayment Concrete.
2. Application: Trowel
3. Compressive Strength 7,000 psi at 7 days; 8200 psi at 28 days, per ASTM C109.
4. Shrinkage: Less than 0.06 percent at 7 days; less than 0.08 percent at 28 days, per ASTM C157, air cured.
5. Low-slump, non-sagging.

- B. Tile Underlayment: Portland-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ardex, K 15.
 - b. BASF Construction Chemicals, Inc.; Chemrex Self-Leveling Underlayment.

- c. Dayton Superior Corporation; LeveLayer.
 - d. Euclid Chemical Company (The); Super Flo-Top.
 - e. MAPEI Corporation; Novoplan Easy.
 - f. USG Corporation; Levelrock SLC 3500.
2. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
 3. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
 4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.
- C. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.
1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- D. Water: Potable and at a temperature of not more than 70 deg F.
- E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
1. Primer shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
1. Treat non-moving substrate cracks to prevent cracks from telegraphing (reflecting) through underlayment.
 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.
- C. Nonporous Substrates: For ceramic tile, quarry tile and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces.
- D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment.

3.2 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 - 2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
 - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, level surface.
 - 1. When aggregate is required in the mix for thickness, apply a final layer of underlayment without aggregate to produce finish surface.
 - 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment. Prevent contamination during application and curing processes.
- E. Do not install floor coverings or waterproofing over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

END OF SECTION 03 54 16

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SECTION 05 50 00
METAL FABRICATIONS

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. Steel framing and supports for applications where framing and supports are not specified in other Sections.
- 2. Shelf angles.

- B. Related Requirements:

- 1. Section 09 91 19 Exterior Painting

1.3 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 metal fabrications that are anchored to or that receive other work. 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.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 2. Loose steel lintels.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.

- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).

2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0677-inch (1.7-mm) minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 Interior Painting."
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.

- E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in masonry construction.

- C. Galvanize and prime exterior miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.8 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
- C. Galvanize[and prime] loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.9 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 09 91 23 "Interior Painting" unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Items Indicated to Receive Primers Specified in Section 09 96 00 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

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SECTION 06 10 00
ROUGH CARPENTRY

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. Framing with dimension lumber.
- 2. Wood blocking and nailers.
- 3. Wood furring.

- B. Related Requirements:

- 1. Section 06 41 16 Interior Architectural Woodwork

1.3 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.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Engineered wood products.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 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, GENERAL

- A. Lumber: 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. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: As indicated in the structural general notes.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process.

2.3 DIMENSION LUMBER FRAMING

- A. Joists, Rafters, and Other Framing: No. 2 grade.
 - 1. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.

2.4 TIMBER FRAMING

A. Comply with the following requirements, according to grading rules of grading agency indicated:

1. Species and Grade: Douglas fir-larch, No. 1 grade; NLGA, WCLIB, or WWPA.
2. Maximum Moisture Content: 19 percent.
3. Additional Restriction: Free of heart centers.

2.5 ENGINEERED WOOD PRODUCTS

A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

B. Dimension Lumber Items: No. 2 grade lumber of:

1. Douglas fir-larch; WCLIB OR WWPA.

C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.7 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: As indicated in the Structural General Notes.

D. Post-Installed Anchors: As indicated in the Structural General Notes.

2.8 METAL FRAMING ANCHORS

A. As indicated in the Structural General Notes.

2.9 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. 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.
- E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- G. 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.
- H. Comply with AWPA 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.
- I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

- 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 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for 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 items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction unless otherwise indicated.
1. Provide continuous horizontal blocking at midheight of partitions more than 96 inches (2438 mm) high, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

3.4 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.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

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SECTION 06 41 16

INTERIOR ARCHITECTURAL WOODWORK

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. Interior standing and running trim.
2. Interior paneling
3. Plastic-laminate cabinets.
4. Plastic-laminate countertops.
5. Shop finishing interior woodwork.
6. Medium density fiberboard, wall paneling.
7. Display case hardware.
8. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.
9. Cabinet hardware and accessories, including cabinet locks.
10. Undercounter support.

- B. Related Requirements:

1. Division 6 Sections for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Division 8 Section "Flush Wood Doors."
3. Division 9 Section "Painting" for field finishing of interior architectural woodwork.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.4 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product, including panel products high-pressure decorative laminate adhesive for bonding plastic laminate and cabinet hardware and accessories.

- B. 1/4" Scale Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.
 - 4. Apply AWI Quality Certification Program label to Shop Drawings.
 - 5. Show pattern direction of laminates or FRP with directional pattern.

- C. Samples for Initial Selection:
 - 1. Plastic laminates.
 - 2. PVC edge material.
 - 3. Thermoset decorative panels.
 - 4. Shop-applied transparent finishes.
 - 5. Shop-applied opaque finishes.

- D. Samples for Verification:
 - 1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
 - 2. Wood-grain plastic laminates, 8 by 10 inches, for each type, pattern and surface finish, with one sample applied to core material and specified edge material applied to one edge.
 - 3. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
 - 4. Exposed cabinet hardware and accessories, one unit for each type and finish.
 - 5. Sample of MDF routed letter. (1) full-size letter sample.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Product Certificates: For the following:
 - 1. Thermoset decorative panels.
 - 2. High-pressure decorative laminate.
 - 3. Adhesives.
- C. Woodwork Quality Standard Compliance Certificates: WI Quality Certification Program certificates.
- D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.7 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. Shop is a certified participant in WI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in WI's Quality Certification Program.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- B. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.
 - 1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
 - 2. Provide for air circulation around stacks and under coverings.
- C. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets 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 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, 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.

1.10 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 8 Section "Door Hardware (Scheduled by Naming Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of the WI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: White Maple, plain sliced.
- C. Wood Species for Opaque Finish: Any closed-grain hardwood.
- D. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD. FSC certified.
 - 3. Particleboard: ANSI A208.1, Grade M-2.
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 5. Hardwood Plywood and Face Veneers: HPVA HP-1, for doors. Birch veneer plywood at drawer boxes.
- E. Composite Wood Products:
 - 1. Medium-Density Fiberboard: ANSI A208.2, Grade MD. FSC certified.
 - 2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 4. Veneer-Faced Panel Products (hardwood Plywood): HPVA HP-1.
- F. Thermoset Decorative Panels: Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

Clarification: The criteria for semi-exposed cabinet interiors called out in this paragraph govern and supersede the designations indicated on the drawings.

- G. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
 - a. Formica Corporation.
 - b. International Paper; Decorative Products Div.
 - c. Laminart.
 - d. Pioneer Plastics Corp.
 - e. Westinghouse Electric Corp.; Specialty Products Div.
 - f. Wilsonart International; Div. of Premark International, Inc.
- H. Adhesive for Bonding Plastic Laminate: Contact cement or as required for substrate and laminate.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with WI Section 10 for grades of architectural plastic-laminate cabinets.

1. Provide labels and certificates from WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: Custom.
- C. Type of Construction: Frameless.
- D. Cabinet, Door, and Drawer Front Interface Style: Reveal overlay.
- E. Reveal Dimension: 1/8 inch.
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by WI quality standard.
- G. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Abet Laminati Inc.
 2. Formica Corporation.
 3. Lamin-Art, Inc.
 4. Pionite; a Panolam Industries International, Inc. brand.
 5. Wilsonart.
- H. Laminate Cladding for Exposed Surfaces:
1. Horizontal Surfaces Other Than Tops: Grade HGL.
 2. Post-formed Surfaces: Grade HGP.
 3. Vertical Surfaces: Grade VGS.
 4. Edges: PVC edge banding, 0.12 inch thick, See Finishes Legend for color, pattern, and finish.
 5. Pattern Direction: Vertically for doors and fixed panels, horizontally for drawer fronts.
- I. Materials for Semi-exposed Surfaces:
1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
 - b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 - c. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
- Clarification:** The criteria for semi-exposed cabinet interiors called out in this paragraph govern and supersede the designations indicated on the drawings.
1. Drawer Sides and Backs: Birch veneer plywood.
 2. Drawer Bottoms: Birch veneer plywood.
- J. Drawer Construction: Fabricate with exposed fronts fastened to sub-front with mounting screws from interior of body.
1. Join sub-fronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
- 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. See Finishes Legend.

2.3 SUBSTRATE MATERIALS

- A. Particle Board: Provide Medium Density Industrial Grade, 45-lb-density panels for thicknesses of 3/4-inch and less, comply with ANSI A208.1 for Grade 1-M-1 except that minimums for modulus of elasticity and screw-holding capacity on face and edge shall be 300,000 psi, 250 lb., and 225 lb., respectively. Use for cabinet boxes only except where specifically noted otherwise.
- B. Fiberboard MDF: Medium-density fiberboard made without formaldehyhde and complying with ANSI A208.2. Provide 48-lb-density panels for thicknesses of 3/4-inch and less. Modulus of elasticity, 520,000; hardness, 1,150; screw holding Face, 325 lb., screw holding edge, 275 lb. Use for countertops, doors, drawers, shelves, and as indicated.
- C. Veneer Core Plywood – For use as typical substrate for plastic laminate. At hinges/face frames, doors, drawer fronts, drawer boxes, 3/4", no voids by States Industries; Eugene, OR.
- D. At sink / wet areas: Reference WI Standards.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 10 "Door Hardware (Descriptive Specification)."
- B. Hardware standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.
- C. Hinges: European style equal to Blum 170° clip hinge.
 - 1. Semi-concealed Hinges for Overlay Doors: BHMA A156.9, B01521.
- D. Wire Pulls: Back mounted, 3 1/2" centers.
 - 1. Equal to Stanley 4483 1/2 wire pull USGD Finish.
- E. Catches: Magnetic catches, equal to Ires SP326.
- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.
 - 1. Open Shelving:
 - a. Standards: KV #85 with anachrome finish.
 - b. Brackets: KV #185, 12" and 18" with anachrome finish.
 - 2. Shelf Standards: (Flush mounted, full groove): KV #255 with #256 supports at all cabinets.
- G. Drawer Slides: BHMA A156.9.
 - 1. Grade 1HD-100 and Grade 1HD-200: Side mounted; 3/4-extension type; zinc-plated-steel ball-bearing slides.
 - a. Equal to BLUM 230 series with 75 lb. rating.
 - 2. File guide standard: equal to Accuride 3832 series, full extension.
 - 3. File drawers: equal to Accuride 3005.
 - 4. Wide drawers: equal to Accuride 4032, full extension.
- H. Door Locks: BHMA A156.11, E07121; Olympus #721 DR or similar to receive Best core. At locations indicated in the Drawings. Owner will supply and install permanent locks.

- I. Drawer Locks: BHMA A156.11, E07041; Olympus #721 DW or similar to receive Best core. At locations indicated in the Drawings. Owner will supply and install permanent cores.
- J. Door and Drawer Silencers: BHMA A156.16, L03011.
- K. Grommets for Cable Passage through Countertops: Molded-plastic grommets and matching plastic caps with slot for wire passage. Provide two at each computer location.
 - 1. Equal to Hafele 63mm or Doug Mockett TG series.
 - 2. Size: 2"
- L. Shelf rests: BHMA A156.9, B04013
- M. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, with exposed edges seamed before tempering, 6 mm thick unless otherwise indicated.
- N. Steel Shelf Bracket:
 - 1. Manufacturer: Crates and pallet (or equal): Available for purchase at Home Depot
 - 2. 12" Forged Steel Shelf bracket
- O. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - 2. Satin Stainless Steel: BHMA 630.
- P. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- Q. Display Case. Note: Allow for 8 week lead time.
 - 1. Glass Door Bottom Rail: CRL Blumcraft 1301-SM with surface mount pivots and locks.
 - 2. Glass Door Top Rail: CRL Blumcraft 1301-SM with surface mount pivots.
 - 3. ½' glass doors, pivot – CRL Blumcraft 1301-CM with 7301 concealed locks, anti-glare (Amiran).
 - 4. Sugatsune VT-DS Slotted Shelving System for ¼" thick tempered glass shelves. See drawings for size and quantity.
22lb load capacity

2.5 UNDER COUNTER SUPPORT

- A. Manufacturer: US Futaba, USF-72531-82-217
- B. Size: 24" x 24" steel.
- C. Finish: Pre-primed flat white finish for field painting.
- D. Installation: Conceal vertical leg/arm in wall cavity.

2.6 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: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.7 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with WI Section 6.
- B. Grade: Custom.
- C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- D. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.
- E. Wood Species and Cut:
 1. Species: See Finish Legend
 2. Plain Sliced
 3. Finger Jointing: Not allowed.
 4. Gluing for Width: Use for lumber trim wider than 6 inches (150 mm).
 5. Veneered Material: Use for lumber trim wider than 6 inches (150 mm).
Face Surface: smooth.

2.8 PANELING

- A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.
 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
 2. Face Veneer Species and Cut: Plain-sliced White Maple.
 3. Veneer Matching: Book match to adjacent leaves, running match within panel face.
 4. Backing Veneer Species: Any hardwood compatible with face species.
 5. Construction: Veneer core.
 6. Glue Bond: Type II (interior).
 7. Grade A per I: Custom standards.
 8. Finish: See Finish Legend
- B. Hardboard Paneling: Interior factory-finished hardboard paneling complying with ANSI A135.5.
 1. Grade A per WI: Custom standards.
 2. Surface-Burning Characteristics: As follows, tested according to ASTM E84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 3. Colors, Textures, and Patterns: See Finish Legend.

2.9 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Comply with WI Section II requirements for high-pressure decorative laminate countertops.
- B. Grade: Custom.
- C. High-Pressure Decorative Laminate Grade: HGS.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Match color, pattern, and finish as indicated on the Finishes Legend.
 - E. Edge Treatment 3mm: PVC, color to match plastic laminate.
 - F. Core Material: See "Substrate Materials".
 - G. Core Material at Sinks: See "Substrate Materials".
- 2.10 PLASTIC LAMINATE WINDOWS SILL
- A. High pressure decorative laminate Grade HGS.
 - B. Edge Treatment: Self-edge.
- 2.11 MDF WOOD PANELING/WAINSCOT FOR OPAQUE AND CLEAR FINISHING
- A. Grade: Custom.
 - B. Finish: See Division 9 - Painting.
 - C. Edge Treatment: Beveled or routed edge: refer to drawings. Sand and fill.
 1. Grade: Custom.
 - a. Apply TR-Z catalyzed lacquer wash coat sealer after staining and before filling.
 2. Sheen: Satin, 30-50 gloss units.
- 2.12 FABRICATION
- A. Fabricate cabinets to dimensions, profiles, and details indicated.

Clarification: In addition to the casework details shown in the drawings, cabinets with plant on backs, as constructed in accordance with WI requirements for Custom grade architectural cabinets, are also acceptable.
 - 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.
 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
 - C. Back out or kerf backs of the following members, except those with ends exposed in finished work:
 1. Interior standing and running trim, except shoe and crown molds.
 2. Wood-board paneling.
 - D. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

- E. 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.
- F. Install glass to comply with applicable requirements in Section 08 80 00 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.13 SHOP FINISHING

- A. Quality Standard: Comply with WI Section 5, unless otherwise indicated.
 - 1. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Back-priming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require back-priming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.
- D. Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523:
 - 1. Grade: Custom.
 - a. Apply TR-Z catalyzed lacquer wash coat sealer after staining and before filling.
 - b. See Finishes Legend for Stain Colors.
 - 2. Sheen: Satin, 30-50 gloss units.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly 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.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. 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 or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60 inches (1500 mm) long, except where shorter single-length pieces are necessary.
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
 - 2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).
 - 3. Stagger joints in adjacent and related standing and running trim.
 - 4. **[Cope]** **[Miter]** at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 5. Use scarf joints for end-to-end joints.
- H. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels.
 - 1. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings.
 - 2. Install with uniform tight joints between panels.
 - 3. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners.
 - 4. Space fasteners and adhesive as recommended by panel manufacturer.
 - 5. Conceal fasteners to greatest practical extent.
 - 6. Arrange panels with grooves and joints over supports.
 - a. Fasten to supports with nails of type and at spacing recommended by panel manufacturer.
 - b. Use fasteners with prefinished heads matching groove color.
- I. Hardboard Paneling: Install according to manufacturer's written instructions.
 - 1. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings.
 - 2. Butt adjacent panels with moderate contact.
 - 3. Use fasteners with prefinished heads matching paneling color.
 - 4. Wood Stud or Furring Substrate: Install with 1-inch (25-mm) annular-ring shank hardboard nails.

5. Plaster or Gypsum-Board Substrate: Install with 1-5/8-inch (41-mm) annular-ring shank hardboard nails.
 6. Nailing: Space nails 4 inches (100 mm) o.c. at panel perimeter and 8 inches (200 mm) o.c. at intermediate supports unless otherwise required by manufacturer.
- J. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
 4. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- K. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in shop.
- L. Refer to Division 9 Sections for final finishing of installed architectural woodwork.
1. At MDF wall panels, the back of MDF panels and the wall substrate to receive the panels are to be prime finished prior to installation of MDF panel.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 06 41 16

SECTION 07 25 00

AIR AND WEATHER BARRIERS (AWB)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Self-adhering sheet flashing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.8 mm).
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. DuPont (E. I. du Pont de Nemours and Company); DuPont Flashing Tape.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Butyl Self Adhered Flashing.
 - c. Raven Industries Inc.; Fortress Flashshield.
 - d. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - e. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Plus Self-Adhered Flashing.
- B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.
- C. Nails and Staples: ASTM F 1667.

PART 3 - EXECUTION

3.1 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 - 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 - 4. Lap water-resistive barrier over flashing at heads of openings.
 - 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 07 25 00

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

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. Manufactured through-wall flashing with counterflashing.
- 2. Formed wall sheet metal fabrications, flashing, coping and trim.

- B. Related Requirements:

- 1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

- 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- 2. Review condition of construction that affect sheet metal flashing and trim.
- 3. Review requirements for insurance and certificates if applicable.
- 4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 - 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 6. Include details of termination points and assemblies.
 - 7. Include details of special conditions.
 - 8. Include details of connections to adjoining work.
 - 9. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is FM Approvals approved.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations 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.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish: Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 3. Colors: Match existing.

4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Solder:
 1. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead with maximum lead content of 0.2 percent.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- C. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- D. Do not use graphite pencils to mark metal surfaces.

2.5 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.

2.6 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Drip Edges: Fabricate from the following material:
 - 1. Pre-painted, metallic-coated steel: 0.022 inch thick. Color – Match adjacent materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. metal flashing and trim.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
 - 1. Do not solder pre-painted metallic-coated steel and aluminum sheet.
 - 2. Do not use torches for soldering. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 - 3. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.3 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 07 92 00

JOINT SEALANTS

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. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Latex joint sealants.
 - 4. Acoustical joint sealants.
- B. Related Requirements:
 - 1. Section 08 80 00 "Glazing" for glazing sealants.
 - 2. Section 09 29 00 "Gypsum Board" for sealing perimeter joints.

1.3 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

- C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.7 PRE-CONSTRUCTION TESTING

- A. Pre-construction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each kind of sealant and joint substrate.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 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.
 - 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 - 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 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.

1.9 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: 20 years for silicones; Five years for polyurethanes 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. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- D. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- E. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- F. Colors of Exposed Joint Sealants: As indicated in Division 9, Finishes Legend.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, non-sag, plus 50 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - d. Pecora Corporation.
 - e. Sika Corporation; Joint Sealants.

2.3 URETHANE JOINT SEALANTS

- A. Multicomponent, Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Bostik, Inc.
 - c. LymTal International Inc.
 - d. Pecora Corporation.
 - e. Sherwin-Williams Company (The).
 - f. Sika Corporation; Joint Sealants.
 - g. Tremco Incorporated.
- B. Single-Component Urethane, NT, O: Single-Component Non-sag, ASTM C 920, Type I, Grade NS, Class 25, VOC content not to exceed 250 g/L.
 - 1. Use NT related to exposure
 - 2. Use O related to vapor-barrier-related substrates

2.4 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, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - d. Soudal USA.
 - e. Tremco Incorporated.

2.5 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Franklin International.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - d. Pecora Corporation.
 - e. Sherwin-Williams Company (The).
 - f. Tremco Incorporated.

2.6 ACOUSTICAL JOINT SEALANT

- A. Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Pecora Corporation: AC-20 FTR.
 - 2. USG Corporation. SHEETROCK Acoustical Sealant.
 - 3. Tremco Inc.; Acoustical Sealant.

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Non-staining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Construction Foam Products; a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), 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.

2.8 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 C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind 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 Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to 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 per Figure 8A in ASTM C 1193 unless otherwise indicated.
 4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. 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.
 4. 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.
 5. 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.

- B. 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.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
 - 1. Joint Locations:
 - a. Perimeter joints between existing conditions and frames of doors, windows and louvers.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturers full range of colors.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation, control and expansion joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Urethane, M, P, 25, T.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturers full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Vertical joints on exposed surfaces of unit masonry, concrete walls and partitions.

- c. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturers full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces not subject to significant movement.
1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Acrylic latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturers full range of colors.
- E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturers full range of colors.
- F. Joint-Sealant Application: Concealed mastics.
1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Butyl-rubber based.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 92 00

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

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 hollow-metal work.
- B. Related Requirements:
 - 1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 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.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. 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 anchorages, joints, field splices, and connections.

7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented 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 work 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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amweld International, LLC.
 2. Ceco Door; ASSA ABLOY.
 3. Curries Company; ASSA ABLOY.
 4. Fleming Door Products Ltd.; Assa Abloy Group Company.
 5. Greensteel Industries, Ltd.
 6. Hollow Metal Inc.
 7. Kewanee Corporation (The).
 8. Republic builder's Products.
 9. Steelcraft; an Ingersoll-Rand company.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. AP-1: Non-rated, flush metal door.
- B. AP-2: Fire-rated, flush metal door.
- C. AP-3: Non-rated, recessed door for gyp insert.
- D. AP-4: Non-rated, flush stainless steel.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 3. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- 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. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: See Section 07 21 00 – Thermal Insulation.
- I. Glazing: Comply with requirements in Section 08 80 00 - Glazing.
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Fire Door Cores: As required to provide fire-protection ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
 - 4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 - 5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 - 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping

or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 2. Provide countersunk, exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in wood-stud partitions.
 7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.
- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

- a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing anti-freezing agents.
 - h. Putty over exposed anchors. Sand and prime for smooth uniform finish.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed 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. Metal-Stud Partitions: 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.
5. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. In-Place Framed Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
7. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb 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 hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

- D. Glazing: Comply with installation requirements in Section 08 80 00 - Glazing and with hollow-metal manufacturer's written instructions.
 - 1. Secure stops with countersunk machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. 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.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

SECTION 08 14 16
FLUSH WOOD DOORS

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. Solid-core doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Factory machining for hardware.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.
- C. Samples for Initial Selection: For factory-finished doors per Finish Legend 09 00 00.
- D. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

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: 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 ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.7 WARRANTY

- A. 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. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include 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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following Basis-of-Design, See Finish Legend:
 - 1. Algoma Hardwoods, Inc.
 - 2. Eggers Industries.
 - 3. Lynden Door.
 - 4. Vancouver Door Company.
 - 5. VT Industries Inc.
 - 6. Weyerhaeuser Company
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Standards."

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: Select White Maple.
3. Cut: Plain Sliced.
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
8. Core: Glued wood stave.
9. Construction: Seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
10. WDMA I.S.1-A Performance Grade: Heavy Duty.

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. Profile: Flush rectangular beads.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 - Glazing.

2.6 SHOP PRIMING

- A. Doors for Transparent Finish: Shop prime faces and all four edges with stain (if required), other required pretreatments. Seal edges of cutouts and mortises with first coat of finish.

2.7 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
 1. Grade: Premium.
 2. Finish: AWI's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
 3. Staining: See Finish Legend.
 4. Effect: Filled finish.
 5. 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 08 71 00 - Door Hardware.
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

3.3 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.

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SECTION 08 33 23
OVERHEAD COILING DOORS

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. Fire-rated service doors.

- B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.
2. Section 06 10 00 "Rough Carpentry" for door opening jamb and head members.
3. Section 09 91 23 "Painting" for finish painting of factory-primed doors.
4. Division 26 Section for electrical service, connections for powered operators, and connection to building life safety systems.

- C. ACTION SUBMITTALS

- D. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

- E. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Show locations of controls, locking devices, detectors and other accessories.
6. Include diagrams for power, signal, and control wiring.

- F. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

- 1. Include similar Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.

- 1. Temperature-Rise Limit: Where indicated, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 2. Smoke Control: In corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. (0.01524 cu. m/s x sq. m) of door opening at 0.10-inch wg (24.9 Pa) for both ambient and elevated temperature tests.

- C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

- 1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.
 2. Testing: According to ASTM E 330 or DASMA 108 for garage doors and meeting the acceptance criteria of DASMA 108.
 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa) wind load, acting inward and outward.
- B. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 FIRE-RATED DOOR ASSEMBLY

- A. Fire-Rated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amarr.
 - b. Clopay Building Products.
 - c. Cookson Company.
 - d. Cornell Iron Works, Inc.
 - e. McKeon Rolling Steel Door Company, Inc.
 - f. Raynor.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
1. Include tamperproof cycle counter.
- C. Fire Rating: Per Door Schedule with temperature-rise limit and with smoke control.
- D. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283.
- E. Door Curtain Material: Stainless steel.
- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
1. Insulated-Slat Interior Facing: Metal.
- G. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats.
- H. Hood: Galvanized steel.
1. Shape: As shown on Drawings.
 2. Mounting: As shown on Drawings.
- I. Locking Devices: Equip door with locking device assembly and chain lock keeper.

1. Locking Device Assembly: Cremona type, both jamb sides locking bars, operable from inside with thumbturn, outside with cylinder.

J. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: Front of hood, wall or as shown on drawings.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
4. Motor Exposure: Interior.
5. Emergency Manual Operation: Crank type.
6. Obstruction Detection Device: Electric sensor edge on bottom bar.
 - a. Sensor Edge Bulb Color: Black.
7. Control Station(s): Keyed where shown on Drawings.
8. Other Equipment: Fire Alarm release interface mechanism.

K. Curtain Accessories: Equip door with smoke seals, automatic closing device, poll hook.

L. Door Finish: Interior Doors.

1. Stainless-Steel Finish: No. 4 (polished directional satin).

2.4 MATERIALS, GENERAL

- 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.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties as follows:
1. Stainless-Steel Door Curtain Slats: ASTM A 666, Type 304; sheet thickness of 0.025 inch (0.64 mm); and as required.
 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks (at insulated doors).

2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
 - 2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.7 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Lock Cylinders: Cylinders specified in Section 08 71 00 "Door Hardware" and keyed to building keying system.
 - 2. Keys: Three for each cylinder.
- B. Chain Lock Keeper: Suitable for padlock.

2.8 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.
- C. Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- D. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- E. Poll Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.
- F. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release mechanism for motor-operated doors shall allow testing without mechanical release of the door. Automatic-closing device shall be designed for activation by the following:

1. Building fire-detection, smoke-detection, and -alarm systems.

2.9 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Chamberlain Group, Inc. (The).
 2. Comply with NFPA 70.
 3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
 1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
 3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
 4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
1. Electrical Characteristics:
 - a. Phase: Polyphase.
 - b. Volts: 115/230 V.
 - c. Hertz: 60.
 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For fire-rated doors, activation delays closing.
1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
- G. Control Station: Key operated control station in fixed location with positions labeled "Close" and "Open".
1. Interior-Mounted Units: Full-guarded, flush-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. 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.

2.12 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

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SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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. Exterior and interior storefront framing.
 - 2. Storefront framing for punched openings with fixed and operable frames.
 - 3. Interior manual-swing entrance doors and door-frame units.

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 aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.
- D. Field quality-control reports.
- E. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

- A. Special Warranty: Manufacturer and/or Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
1. Wind Loads: As indicated on Drawings.
 - a. Basic Wind Speed: 110 mph
 - b. Risk Category of Building: 11
 - c. Exposure Category: B

2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
- E. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Per NFRC 400, maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.
 2. Swinging Entrance Doors and Windows:
 - a. Pair of Doors: Maximum air leakage of 0.20 cfm/sq. ft. per NFRC 400 or 0.30 cfm/sq. ft. of fenestration or door area when tested in accordance with AAMA/WDMA/CSA 101/I.S. A440 at 6.24 psf.
 - b. Single Doors: Maximum air leakage of 0.20 cfm/sq. ft. per NFRC 400 or 0.30 cfm/sq. ft. of fenestration or door area when tested in accordance with AAMA/WDMA/CSA 101/I.S. A440 at 6.24 psf.
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.
- H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.
 2. Maximum Water Leakage: According to AAMA 501.1 No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

- I. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- J. Energy Performance: Certify and label energy performance according to NFRC as follows:
 - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.38 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
 - 2. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
 - 3. Solar Heat Gain Coefficient: Fixed and operable glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined to NFRC 200.
 - 4. Each piece of glazing shall have an "Energy Performance Certificate" adhered to the entrance doors and storefront at the factory, verifying performance values for each assembly.
- K. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332, as follows.
 - 1. Outdoor-Indoor Transmission Class - Minimum 26
- L. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
 - 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
 - c. Interior Ambient-Air Temperature: 75 deg F.

2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer TriFab VG 451T aluminum storefront system with 500 Heavy Wall entrance doors at windows and entrances at exterior locations (SF-1). Provide Kawneer TriFab 400 aluminum storefront system with 500 Heavy Wall entrance doors at windows and entrances at interior locations (SF-2). Subject to compliance with requirements and properties of the products listed, products by one of the following may be considered:
 - 1. Arcadia, Inc.
 - 2. EFCO Corporation, Series 500.
 - 3. Vistawall Architectural Products.
 - 4. Marlin Windows.
 - 5. Pacific Aluminum.
 - 6. Wausau Window and Wall Systems.
 - 7. Oldcastle Building Envelope.
 - 8. YKK AP America, Inc.
- B. Source Limitations:

1. Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels venting windows and accessories, from single manufacturer.
2. Aluminum storefront and curtainwall to be sourced from a single manufacturer.

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken at exterior glazing.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front
 4. Finish: Color anodic finish High-performance organic finish as indicated on Finish Legend 09 00 01.
 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's 500 Heavy Wall doors and frame for manual and automatic swing operation.
1. Door Construction: 2 inch (50.8mm) overall thickness with minimum 3/16-inch (4.76-mm) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie rods.

- a. Thermal Construction at Exterior Doors: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 - b. Glass at exterior door vision lights to be 1/4" clear tempered single light. Glass at interior doors and windows at secure vestibule to be clear laminated single light.
2. Door Design: Wide stile; 6-inch (127-mm) nominal width.
 - a. Accessible Doors: Smooth surfaced for width of door in area within 12 inches above floor or ground plane.
 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and performed gaskets.
 - a. Provide non-removable glazing stops on outside of door.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 3. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion.
 - b. Accessible Interior Doors: Not more than 5 lbf to fully open door.
 4. Hinge: Continuous equal to Pemco #CFSIDFS HD or select #SL21 HD

2.6 GLAZING

- A. Glazing: Comply with Section 08 80 00 - Glazing.
- B. Glazing Gaskets: Manufacturer's standard, replaceable, sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
- D. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.
 1. Color: Match frame color.

2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using shear-block system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.

2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: As indicated on the Finish Legend, Section 09 00 01.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, 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. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

- A. General:
1. Comply with manufacturer's written instructions.
 2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure non-movement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 08 80 00 - Glazing.
- G. Install weatherseal sealant according to Section 07 92 00 - Joint Sealants, and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of two tests in areas as directed by Architect.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 08 41 13

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SECTION 08 71 00

DOOR HARDWARE

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 this Section.

1.2 SUMMARY

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 8 Section "Standard Steel Doors and Frames" for hardware used with hollow metal frames.
 - 2. Division 8 Section "Wood Doors" for factory prefitting and factory premachining of doors for door hardware.
 - 3. Division 8 Section "Aluminum Storefronts" for hardware used with aluminum doors and frames.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
 - 1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size, and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - e. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for hardware.
 - g. Door and frame sizes and materials.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.

- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
- C. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels. If automatic self-latching bolts, coordinators, and astragals are required they shall be furnished.

PART 2 – PRODUCTS

2.1 PRODUCT HANDLING:

- A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate door number to match door numbers of approved hardware schedule.
- C. Inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that the count is correct.
- D. Deliver individually packaged items at the proper times to the proper locations (shop or project site) for installation.
- E. Provide secure lock-up for hardware delivered to the project, but not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

2.2 MANUFACTURERS

- A. The numbers shown in the hardware groups are taken from the catalogs of the following manufacturers and are for the purpose of establishing quality, design, function and finish. Except as listed, no substitutes will be allowed, unless approved by the architect prior to bid opening. No substitutions will be allowed after bid opening. Requests for approval must be made to the architect. All substitutions must be from hardware distributors, not factory representatives.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Butts and Hinges:
 - a. Bommer Industries, Inc.
 - b. McKinney Products Co.
 - 2. Locks:
 - a. Schlage Lock.

3. Cylinders:
 - a. KABA-Peaks, furnished by Owner.
 1. For new construction and renovations, unless otherwise specified and approved by the Owner, all locks shall be capable of receiving a Small Format Interchangeable Core (SFIC).
4. Bolts:
 - a. Rockwood Manufacturing Co.
 - b. Triangle Brass Manufacturing Company (Trimco).
 - c. Ives
5. Overhead Closers:
 - a. LCN Closers.
6. Door Control Devices:
 - a. Rockwood Manufacturing Co.
 - b. Triangle Brass Manufacturing Company (Trimco).
 - c. Ives.
 - d. Glynn-Johnson
7. Pushes, Pulls and Kick plates:
 - a. Rockwood Manufacturing Co.
 - b. Triangle Brass Manufacturing Company (Trimco).
 - c. Ives

2.3 MATERIALS AND FABRICATION:

- A. Hand of Door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified standard applicable hardware units by applicable ANSI A156 series standard for each type hardware item and with ANSI A156.18 for finish designation indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.
- C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- D. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
- E. Provide concealed fasteners for hardware units which are exposed when door is closed, except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.

- F. Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.4 HINGES, BUTTS AND PIVOTS:

- A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template produced units.
- B. Screws: Furnish Phillips flat-head machine screws for installation of units, except furnish Phillips flat-head wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.
- C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - 1. Steel Hinges: Steel pins.
 - 2. Non-ferrous Hinges: Stainless steel pins.
 - 3. Out-swinging Lockable Doors: Non-removable pins.
 - 4. Interior Doors: Non-rising pins.
 - 5. Tips: Flat button and matching plug, finished to match leaves, except where hospital tip (HT) indicated.
- D. Number of Hinges: Provide number of hinges indicated but not less than one pair of hinges for each door up to 60" in height. Furnish one each additional hinge for every additional 30" or fraction thereof.

- E. Continuous Hinges: Provide heavy duty full mortise type continuous hinges at all exterior openings and where noted in hardware sets.

2.5 LOCK CYLINDERS AND KEYING:

- A. All permanent cylinders shall be KABA-Peaks furnished by Owner.
- B. All permanent cylinders shall be installed in the locks by the hardware installer as directed by the owner.

2.6 LOCKS, LATCHES AND BOLTS:

- A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware.
 - 1. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.
- B. Lock Throw: Provide 1/2" minimum throw of latchbolts on single doors, 1" minimum throw of deadbolts. Provide 3/4" minimum throw of latchbolts on UL rated pairs of doors where required by code.
- C. Flush Bolt Heads: Minimum of 1/2" diameter rods of brass, bronze or stainless steel, with minimum 12" long rod door doors up to 7'-0" in height. Provide longer rods as necessary for doors exceeding 7'-0" in height.
- D. Exit Device Dogging: Except on fire-rated doors, wherever closers are provided on doors equipped with exit devices, equip the units with a keyed dogging device to hold the push bar down and the latch bolt in the open position.

- E. Shim Kits: On doors with vision panels extending below the exit device mounting height, provide shim kits to space the exit device away from the door sufficient distance to clear the vision panel.
- 2.7 PUSH/PULL UNITS:
- A. Exposed fasteners: Provide manufacturer's standard exposed fasteners for installation; through-bolted for match pairs, but not for single units.
- 2.8 CLOSERS AND DOOR CONTROL DEVICES:
- A. Size of units. Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use. Provide parallel arms for all overhead closers except as otherwise noted. Furnish drop plates and accessories as required for project conditions.
- 2.9 DOOR TRIM UNITS:
- A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units); either machine screws or self-tapping screws.
 - B. Fabricate protection plates (armor, kick or mop) not more than 2" less than door width x the height indicated, beveled four edges
- 2.10 WEATHERSTRIPPING:
- A. General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf. Provide type, sizes and profiles shown or scheduled. Provide non-corrosive fasteners as recommended by manufacturer for application indicated.
 - B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stock maintained by manufacturer.
- 2.11 THRESHOLDS:
- A. General: Except as otherwise indicated provide standard metal threshold unit of type, size and profile as shown or scheduled.
- 2.12 HARDWARE FINISHES:
- A. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units) for color and texture.
 - B. Provide finishes which match those established by BHMA or, if none established, match the Architect's sample.
 - C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standard, but in no case less than specified for the applicable units of hardware by referenced standards.

- D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI A156.18 "Materials & Finishes Standard", including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.
- E. Hardware in general to be US26D or US32D. Lock trim to be 626.
 Door closers to be in lacquered finish to match other hardware

2.12 HARDWARE SETS

- A. Hardware sets indicate quantity, item, manufacturer and product designation, size, and finish or color, as applicable.

HW 01

1	EA	ANCHOR PIVOT	7004-045	652	BOM
3	EA	HINGE	BB5000-450	652	BOM
1	EA	STOREROOM LOCK	ND80BD RHO	626	SCH
1	EA	CYLINDER BY OWNER	KABA	626	KAB
1	EA	ELECTRIC STRIKE	6211-FSE	630	VON
1	EA	OH STOP/HOLDER	900-H	652	GLY
1	EA	KICKPLATE	8400 10" X 2" LDW	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
ACCESS CONTROL BY OTHERS					

HW 02

6	EA	HINGE	BB5000-450N	652	BOM
1	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	MULLION	KR4954	689	VON
1	EA	EXIT DEVICE	99EO	626	VON
1	EA	EXIT DEVICE	QEL99L 996L	626	VON
1	EA	CYLINDER BY OWNER	KABA	626	KAB
2	EA	CLOSER	4111 EDA	689	LCN
2	EA	WALL STOP	WS402CCV	626	IVE
ACCESS CONTROL BY OTHERS					

HW 03

3	EA	HINGE	BB5000-450N	652	BOM
1	EA	STOREROOM LOCK	ND80BD RHO	626	SCH
1	EA	CYLINDER BY OWNER	KABA	626	KAB
1	EA	ELECTRIC STRIKE	6211-FSE	630	VON
2	EA	CLOSER	4111 EDA	689	LCN
1	EA	WALL STOP	WS402CCV	626	IVE
ACCESS CONTROL BY OTHERS					

HW 04

3	EA	HINGE	BB5000-450	652	BOM
1	EA	STOREROOM LOCK	ND80BD RHO	626	SCH
1	EA	CYLINDER BY OWNER	KABA	626	KAB
1	EA	ELECTRIC STRIKE	6211-FSE	630	VON
1	EA	WALL STOP	WS402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE
			ACCESS CONTROL BY OTHERS		

HW 05

1	EA	ANCHOR PIVOT	7004-045	652	BOM
3	EA	HINGE	BB5000-450	652	BOM
1	EA	PASSAGE LATCH	ND10S RHO	626	SCH
1	EA	OH STOP	900-S	652	GLY
3	EA	SILENCER	SR64	GRY	IVE

HW 06

1	EA	STOREROOM LOCK	ND80BD RHO	626	SCH
1	EA	CYLINDER BY OWNER	KABA	626	KAB
1	EA	ELECTRIC STRIKE	6211-FSE	630	VON
			BAL OF HDWE EXISTING		
			ACCESS CONTROL BY OTHERS		

HW 07

1	EA	ELECT HINGE	BB5060-450-ETW04	652	BOM
1	EA	STOREROOM LOCK	ND80BD RHO	626	SCH
1	EA	CYLINDER BY OWNER	KABA	626	KAB
1	EA	ELECTRIC STRIKE	6223-FSE	630	VON
			BAL OF HDWE EXISTING		
			ACCESS CONTROL BY OTHERS		

HW 08

1	EA	ANCHOR PIVOT	7004-045	652	BOM
3	EA	HINGE	BB5000-450	652	BOM
1	EA	STOREROOM LOCK	ND80BD RHO	626	SCH
1	EA	CYLINDER BY OWNER	KABA	626	KAB
1	EA	OH STOP/HOLDER	900-S	652	GLY
1	EA	KICKPLATE	8400 10" X 2" LDW	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

PART 3 - EXECUTION

3.1 INSTALLATION:

Mount hardware units at heights indicated in Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.

Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division-9 sections. Do not install surface-mounted items until finishes have been completed on the substrate.

Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill and counter sink units which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

3.2 ADJUST AND CLEAN:

Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustments of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilation equipment.

Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finish during the final adjustment of hardware.

END SECTION 08 71 00

SECTION 08 80 00

GLAZING

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. Glass for windows, doors, interior borrowed lites and storefront windows.
 - 2. Glazing sealants and accessories.

1.3 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 according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.6 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 (300 mm) square.
 - 1. Insulated glass.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and glass testing agency.
- B. Product Certificates: For glass.
- C. Product Test Reports: For insulating glass, for tests performed by a qualified testing agency.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to 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.

1.10 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 (4.4 deg C).

1.11 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 the 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AGC Glass Company North America, Inc.
 - 2. Cardinal Glass Industries.
 - 3. Cristacurva.
 - 4. Dlubak Corporation.
 - 5. Gardner Glass, Inc.
 - 6. GGI; General Glass International.
 - 7. Glasswerks LA, Inc.
 - 8. GTI; Glaz-Tech Industries.
 - 9. Guardian Industries Corp.; SunGuard.
 - 10. Hartung Glass Industries.
 - 11. JE Berkowitz, LP.
 - 12. Northwestern Industries, Inc.
 - 13. Oldcastle BuildingEnvelope™.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain reflective-coated glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

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 the following: 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. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings.
 2. Design Wind Pressures: As indicated on Drawings.
 - a. Wind Design Data: As indicated on Drawings.
 - b. Basic Wind Speed: As indicated on Drawings.
 - c. Importance Factor: As indicated on Drawings.
 - d. Exposure Category: As indicated on Drawings.
 3. Design Snow Loads: As indicated on Drawings.
 4. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
 5. 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 (25 mm), whichever is less.
 6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Safety Glazing: Where safety glazing is required by IBC 2406, 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 monolithic-glass lites, properties are based on units with lites 6 mm thick.
 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

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. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum.
- E. 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 C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, 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 C 1048, 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.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard.
2. Spacer: Manufacturer's standard spacer material and construction.
 - a. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) Technoform Glass Insulation NA, Inc.
 - 2) Thermix; a brand of Ensinger USA.

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. Voc limit not to exceed 250g/L.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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 C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. 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 the 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, with requirements of 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: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

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 (1270 mm).
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 (3-mm) 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 according to 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 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 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 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 come into 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. Glass Type GL-1 (Interior Windows and Relights): Clear heat-strengthened or fully tempered float glass, based on location per IBC Chapter 24.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing as required by IBC Chapter 24.

3.8 INSULATING GLASS SCHEDULE

- A. Glass Type IG-1: Low-E coated, clear insulating glass at designated locations for storefront and curtain wall.
 - 1. Basis-of-Design Product: Vitro – Solarban 70XL.
 - 2. Overall Unit Thickness: 1 inch (25 mm).
 - 3. Minimum Thickness of Each Glass Lite: 6 mm.
 - 4. Outdoor Lite: Heat strengthened or fully tempered float glass.
 - 5. Interspace Content: Argon.
 - 6. Indoor Lite: Heat strengthened or fully tempered float glass.
 - 7. Low-E Coating: Sputtered on second surface.
 - 8. Winter Nighttime U-Factor: 0.28 maximum.
 - 9. Visible Light Transmittance: 64 percent minimum.
 - 10. Solar Heat Gain Coefficient: 0.27 maximum.
 - 11. Safety as glazing required by IBC Section Chapter 24.

END OF SECTION 08 80 00

|-----Walls-----|

Room No. & Name	Base	North	East	South	West	Ceiling	Remarks
100 MALL							
100L HALL							*NO WORKTHIS AREA
100K STAIR							*NO WORKTHIS AREA
102A FOOD BANK	LIN-1	P-1	P-1	P-1	P-1		*EXISTING
102B GALLERY	CPT-3	P-1	MDF* P-1	P-1	MDF*	P-2	MDF*: See Int. Elevations for paint finish
102C DATA							*NO WORKTHIS AREA
102D LEADERSHIP	CPT-3	P*	P*	P-1	P-2		*See RCP P*: See Int. Elevations for paint finish
103 MEETING ROOM	CPT-2	P-1	P-1	VWC-1	STRFRONT	APC-1 P-6	* Soffit to the East
104 OFFICE	CPT-3	P-1	P-1	MDF* P-1	P-1	APC-1 P-6	MDF*: See Int. Elevations for paint finish
105 STORAGE/WK ROOM	*EXISTING						*EXISTING
114A TOILET ROOM							*NO WORKTHIS AREA
114B TOILET ROOM							*NO WORKTHIS AREA

|-----Walls-----|

Room No. & Name	Floor Finish	Base	North	East	South	West	Ceiling	Remarks
114C STORAGE	*EXISTING	*EXISTING	P-1	P-1	P-1	P-1	*EXISTING	
114D ELECTRICAL				*NO WORKTHIS AREA				
114E PROJ. COORD.				*NO WORKTHIS AREA				
114F STORAGE				*NO WORKTHIS AREA				
114G PROJ. COORD.				*NO WORKTHIS AREA				
115 LOUNGE AREA	LIN-1 CPT-2	RB-1	*See Int. Elev	*See Int. Elev	*See Int. Elev	P-6	WLC-1 P* CLG GRID	P*: See RCP
115A GALLERY	LIN-1	RB-1	P-1	P*	P*	P*	P-2	P*: See Int. Elevations for paint finish
115B RECEPTION	LIN-1 CPT-2	RB-1	*See Int. Elev	*See Int. Elev	*See Int. Elev	*See Int. Elev	FILM-2 P* WLC-1 (Alt. 2)	P*: See RCP
115C COMPUTER LAB	CPT-1	RB-1	P-6	P-6	N/A	N/A	*EXISTING	
115D HALL	CPT-1	RB-1	P-6	P-1	P-1	N/A	*EXISTING	
115E HALL	CPT-2	RB-1	P-6	P-1	P-1	P-1	P-2	

|-----Walls-----|

Room No. & Name	Finish	Base	North	East	South	West	Ceiling	Remarks
116 GLOBAL AMERICAN SUCCESS	CPT-1	RB-1	P-1	P-1	P-1	P-1	*EXISTING	
117 GLOBAL PROJ.	CPT-1	RB-1	P-1	P-1	P-1	P-1	*EXISTING	
118 GLOBAL STUDY ABROAD	CPT-1	RB-1	P-1	P-1	P-1	P-1	*EXISTING	
119 GLOBAL RECRUIT	CPT-1	RB-1	P-1	P-1	P-1	P-1	*EXISTING	
120 CONFERENCE	CPT-1	RB-1	P-1	P-1	P-1	P-1	*EXISTING	
121 GLOBAL DEAN	CPT-1	RB-1	P-1	P-1	P-1	P-1	*EXISTING	
122 GLOBAL HOMESTAY	CPT-1	RB-1	P-1	P-1	P-1	P-1	*EXISTING	
123 PRIDE MEETING RM	CPT-2	RB-1	P-1	P-1	P-3	P-1	P-2	
124 MULTI CULTURAL OFFICE	CPT-1	RB-1	P-1	P-1	P-1	P-1	APC-1	
125 GLOBAL OFFICE ASSISTANT	CPT-1	RB-1	P-1	P-1	P-1	P-1	APC-1	
126 MEDITATION	CPT-1 LIN-1	RB-1	P-1	P-1	P-1	P-1	P-2	
130 ALT-1 OFFICE								

|-----Walls-----|

Room No. & Name	Floor Finish	Base	North	East	South	West	Ceiling	Remarks
131 ALT-1 OFFICE	CPT-3* (NOTE 1)	RB-1	P-1 (NOTE 1)	P-1	P-1	P-1 (NOTE 1)	*EXISTING (NOTE 1)	(NOTE 1): part of base bid
132 ALT-1 OFFICE	CPT-3* (NOTE 1)	RB-1	P-1 (NOTE 1)	P-1 (NOTE 1)	P-1 (NOTE 1)	P-1	*EXISTING (NOTE 1)	(NOTE 1): part of base bid
	CPT-3* (NOTE 1)	RB-1	P-1 (NOTE 1)	P-1 (NOTE 1)	P-1	P-1	*EXISTING (NOTE 1)	(NOTE 1): part of base bid

NOTE: Where multiple finishes are listed, refer to interior elevations for placement.

END OF FINISH LEGEND

Spec.
Section

Section	Item	Keyword	Manufacturer	Description	Color/Finish
03 30 00	Sealed Concrete	CONC (Sealed)			
06 41 16	Solid Surfacing Countertops	SSC-1	Corian		Organic Cotton 4945-38
	Plastic Laminate	PLAM-1	Wilsonart	Fine Velvet texture	
		PLAM-2	Formica	Natural Grain	
		PLAM-3	Formica	Matte Finish	Mouse 928-58
	Wood Paneling	WD-1	(solid or wood veneer at substrate)	White Maple Plain Sliced	Clear stain to match Architects sample
		WD-2	(solid or wood veneer at substrate)	White Maple Plain sliced	Stained to match Architects sample
	MDF Paneling	MDF-1		½" MDF – paint as noted in drawings Use 4x8 standards sheet size or 4x10 sheet size where noted in Int. Elevations.	Painted
	Casework Reveal	CWRV-1	Fry Reglet #JDM-50	½" J Mold	Manufacturer's standard
08 11 13	Hollow Metal Doors and Frames	HM Frame		Hollow Metal Door Frames	Color: Paint to match P-5
08 14 16	Flush Wood Doors	WOOD DR	Lynden Door (or equal)	Architectural Series: Veneer White Maple Grade A Plain Sliced/book matched	Clear seal
08 41 13	Aluminum-Framed Entrances & Storefronts	SF	Kawneer: See Specifications for types at Exterior and Interior		Black #29
09 29 00	Reveals	RV-1			
		RV-2			
09 51 13	Acoustical Panel Ceilings	APC-1	Armstrong: Cortega #747	24" x 48" Grid: Prelude 15/16" square lay in	White
		CLG TRIM	Armstrong	15/16" Flush Act. To Drywall Transition Molding 120" x 2 11/16"	White

Spec. Section	Item	Keyword	Manufacturer	Description	Color/Finish
	Wood Linear Ceilings	COVE LIGHT WLC-1 (Alt. 2)	Armstrong: Direct Light Cove #AXDLC44 9 Wood	Pre-engineered direct light cove 4"x4" Solid Western Hemlock 1100 Cross Piece Grille 5/8" w x 2'-1/4" d 3" O.C.	Maple stain
09 65 13	Rubber Base and Accessories	RB-1	Johnsonite	4"h rubber base with toe	Black 40
09 65 13 Cont.	Transition Strip/Reducer	TS-1 TS-2 TS-3	Johnsonite: Metal Edge 001 Johnsonite	ME-001 CPT to LIN transitions Reducer transitions Existing tile to LIN or CPT	Ironstone 178 Charcoal 20
09 65 43	Resilient Sheet Flooring	LIN-1	Forbo: Marmoleum Concrete	Sheet	Comet 3703
09 68 13	Tile Carpeting	CPT-1 CPT-2 CPT-3	Shaw Contract Shaw Contract Shaw Contract	Turn Tile 5T205 12" x 48" Install Method: Brick Track Tile 5T204 12" x 48" Install Method: Stagger Dash Tile 5T203 12" x 48" Install Method: Brick	Strategy 04555 Meditate 04327 Strategy 04555
09 91 23	Painting	P-1 P-2 P-3 P-4 P-5 P-6	Sherwin Williams Sherwin Williams Sherwin Williams Sherwin Williams Sherwin Williams Sherwin Williams	(Neutral) (ceiling white) (teal) (blue) (black) (dark neutral)	Silverpointe SW 7653 Rhinstone SW 7656 Surfin' SW 9048 Blue Plate SW 6796 Black Fox SW7020 Gauntlet Gray SW 7019

Spec.

Section	Item	Keyword	Manufacturer	Description	Color/Finish
09 72 00	Wallcovering	VWC-1	MDC: Dry Erase Wallcovering	DWW15101 60" dry erase wallcovering	White
		VWC-2	MDC: Digital Studio Project #42050-65809	Custom digital graphic; image to be provided by Architect See Int. Elevation for extents	Suede substrate
10 50 00	Corner Guards	CG-1	Korogard: AC Anodized Aluminum Cornerguard	1/2" wing x custom height. See Int. Elevations	Black
		CG-2	Korogard: AC Anodized Aluminum Cornerguard	1/2" wing x 4' See Int. Elevations	Satin
		FILM-1	Decorative Films	Semi-private film Install office side	Shimera SX-3160
		FILM-2	3M: Di-Noc Architectural Finishes	60"H roll – run roll horizontally 4'w x 164'l	FW-1214
12 21 13	Horizontal Louver Blinds	HLB	Levelor	Riviera Dustguard; 1" Aluminum	Per manufacturer's standards
12 24 13	Roller Shades	RS-1	Mechoshade : Soho 1100 Series	1% Openness Manual Jamb Mount	Per manufacturer's standards
	Roller Shades	RS-2 (Alt .3)	Mechoshade : Soho 1100 Series	1% Openness Manual Jamb Mount	Per manufacturer's standards

END OF FINISH LEGEND 09 00 01

Spec. Section	Item	Keyword	Manufacturer	Description	Color/Finish
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SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

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. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.
 - 3. Grid suspension systems for gypsum board ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 2. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
1. Steel Studs and Runners:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) MBA Building Supplies.
 - 3) MRI Steel Framing, LLC.
 - 4) Phillips Manufacturing Co.
 - 5) Steel Network, Inc. (The).
 - 6) Telling Industries.
 - b. Minimum Base-Metal Thickness: As indicated on Drawings or 0.0179 inch (0.455 mm).
 - c. Depth: As indicated on Drawings.
- C. 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 runners while allowing 2-inch minimum vertical movement.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) ClarkDietrich Building Systems.
 - 3) Fire Trak Corp.
 - 4) Steel Network, Inc. (The).
 - 5) Super Stud Building Products Inc.
 2. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 3. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 4. Deflection Track: Steel sheet top runner 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, provide products by one of the following:
 - 1) Blazeframe Industries.
 - 2) CEMCO; California Expanded Metal Products Co.

- 3) ClarkDietrich Building Systems.
 - 4) MBA Building Supplies.
 - 5) Metal-Lite.
 - 6) Perfect Wall, Inc.
 - 7) Steel Network, Inc. (The).
 - 8) Telling Industries.
- D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blazeframe Industries.
 - b. CEMCO; California Expanded Metal Products Co.
 - c. ClarkDietrich Building Systems.
 - d. Fire Trak Corp.
 - e. Metal-Lite.
 - f. Perfect Wall, Inc.
 - g. Steel Network, Inc. (The).
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: As indicated on Drawings.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch wide flanges.
1. Depth: 1-1/2 inches.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.0296 inch.
 2. Depth: As indicated on Drawings.
- H. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical or hat shaped.
- I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch wide flanges.
1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch diameter wire.
- J. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
 - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch wide flanges.
 - 1. Depth: 2-1/2 inches.
- F. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0179 inch.
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: 0.0296 inch.
 - 4. Resilient Furring Channels: 1/2-inch deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Chicago Metallic Corporation.
 - c. United States Gypsum Company.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), non-perforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas 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 C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 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 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacing indicated, but not greater than spacing required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 24 inches o.c. unless otherwise indicated.
 - 2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
 - 3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- 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 (runners) 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 runner 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 (13-mm) 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.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Shaped Furring Members:
 - 1. Erect insulation, specified in Section 07 21 00 "Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- G. 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 INSTALLING 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.
 3. Furring Channels (Furring Members): 24 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, counter-splaying, 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. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. 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.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. 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 09 22 16

SECTION 09 29 00

GYPSUM BOARD

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. Interior gypsum board.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 2. Simulate finished lighting conditions for review of mockups.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 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.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 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 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. 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 C 1396/C 1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Continental Building Products, LLC.
 - d. Georgia-Pacific Building Products.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.
 - g. Temple-Inland Building Products by Georgia-Pacific.
 - h. United States Gypsum Company.
 - 2. Thickness: 5/8 inch.
 - 3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.
 - 3. Reveals and Moldings: Refer to Section 09 00 01 – Finish Legend.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- 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, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Tile Backing Panels:
 - 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 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.
- D. Sound-Attenuation Blankets: See "Mineral Wool Blanket" paragraph in Section 07 21 00 – Thermal Insulation.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Section 07 92 00 – Joint Sealants.
- F. Thermal Insulation: As specified in Section 07 21 00 - Thermal Insulation.
- G. Vapor Retarder: As specified in Section 07 21 00 – 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 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 2. Type X: Vertical surfaces unless otherwise indicated.
 3. Ceiling Type: Ceiling surfaces.
- 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 vertically (parallel 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 high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLING 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 at locations indicated on Drawings, according to ASTM C 840 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. LC-Bead: Use at exposed panel edges.
 3. L-Bead: Use where indicated.
 4. U-Bead: Use at exposed panel edges where indicated.

3.5 FINISHING 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, rounded or 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 according to ASTM C 840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 3: Where indicated on Drawings.
 4. 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 09 91 00 - Painting.
 5. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 09 91 00 - Painting.

3.6 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 09 29 00

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SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes acoustical panels with exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices.

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. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Set of 6-inch square Samples of each type, color, pattern, and texture (if new panels required).
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch long Samples of each type, finish, and color.
- C. Delegated-Design Submittal: For seismic restraints for ceiling systems.
 - 1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 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. Acoustical Ceiling Units: Full-size panels equal to 1 percent of quantity installed.
 2. Suspension-System Components: Quantity of each exposed component equal to 1 percent of quantity installed.
 3. Boxes are to be marked with campus, building name and number and room number. Obtain a receipt when delivered to the College and furnish receipt at project closeout.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels (if new panels required), suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 - Quality Requirements, to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E 1264.
 - 2. Smoke-Developed Index: 450 or less.

- D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

- A. Manufacturers: Products to comply with Greenguard™. Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. Armstrong World Industries, Inc.
 - 3. CertainTeed Corporation.
 - 4. Chicago Metallic Corporation.
 - 5. Tectum Inc.

- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

2.4 ACOUSTICAL PANELS, GENERAL (Refer to this section if new acoustical ceiling panels are required)

- A. Note: New APC to be new CLG grid and salvaged reused ceiling tiles.

- B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

- C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

- D. Classification: Provide panels complying with ASTM E 1264 for Type III, mineral base with membrane-faced overlay; Form 2, water felted.

- 2.5 WATER-FELTED, MINERAL-BASE ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING (APC-1)
- A. Products: Armstrong Cortega #747
 - B. Classification: Provide panels complying with ASTM E 1264 for Type III, mineral base with membrane-faced overlay; Form 2, water felted.
 - C. Color: White.
 - D. LR: Not less than .83
 - E. NRC: Not less than 0.55
 - F. CAC: Not less than 40.
 - G. Edge Detail: Square
 - H. Thickness: 5/8"
 - I. Size: 24 by 48 inches.
- 2.6 PERIMETER DIRECT LIGHT COVES (At Mediation Room 126)
- A. Basis of Design: Axiom® Direct Light Coves; Armstrong® World Industries, Inc.
 - B. System: An extruded aluminum light cove system fully concealed integrated design to create a light cove profile with integrated light fixture; see Electrical Lighting Schedule. Installs with manufacturers acoustical and drywall suspension systems. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint (white) color to match intersecting grid system. Commercial quality aluminum unfinished t-bar connection clips; galvanized steel splice plates.
 - C. Components:
 - 1. Axiom® Direct Light Cove Systems: Extended aluminum direct light cove with distinct architectural features creates a 2-sided light cove at the wall. Special bosses are designed to connect AXTBC T-bar connector clip and splice plate; factory finished to match approved samples; factory or field cut miters to match approved shop drawings.
 - a. AXDLC44 – 4 x 4" Direct Light cove, 120 x 4-1/2 x 4"
 - 1) AX2HGC – Hanging Clip included
 - 2) AXTBC – T-Bar Connector Clip included
 - 3) AX4SPLICE – Axiom Splice Plate included
 - 4) AXPWCCP – Axiom Wall Clip included
 - 2. Axiom® Direct Light Cove Accessories
 - a. AXBTSTR – Axiom® Drywall Bottom Trim (If you do not need this then you can remove this from the spec)

2.7 METAL SUSPENSION SYSTEM

- A. Note: New ceiling panel suspension system to match existing. Below description of grid is assumed for estimating purposes, but exact type/size to be field verified with existing grid prior to submittals.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. Chicago Metallic Corporation.
 - 4. United States Gypsum Company.
- C. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
- D. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; pre-painted, electrolytic zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished metal caps on flanges.
 - 1. Size: Select size to suit tile as shown on 09 00 01 Finish Legend.
 - a. 15/16 inch wide
 - 2. Structural Classification: Intermediate-duty system.
 - 3. End Condition of Cross Runners: butt-edge type.
 - 4. Face Design: Flat, flush.
 - 5. Cap Material: Cold-rolled steel.
 - 6. Cap Finish: Painted to match ceiling tiles/grid.
- E. Fire Rated Suspension System: Provide manufacturer's standard, direct-hung metal suspension system and accessories equal to Prelude FireGuard and XL FireGuard with steel cap.

2.8 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch diameter bolts.

- F. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
- G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.9 METAL CLG TRIM

- A. Products: Subject to compliance with requirements, provide the following:
 - 1. Armstrong World Industries, Inc.; #7904 . Color: White.
 - a. 15/16" Flush APG to Gypsum board transition
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 - 3. Conversion-Coated and Factory-Primed Finish: AA-M12C42R1x (Chemical Finish: cleaned with inhibited chemicals; acid-chromate-fluoride-phosphate conversion coating; organic coating as follows):
 - a. Manufacturer's standard, factory-applied prime-coat finish ready for field painting.
 - 4. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; organic coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - a. Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of 0.8 to 1.2 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION – ACOUSTICAL CEILINGS

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.

- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 4. Install seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 54 26
LINEAR WOOD CEILINGS (ALT.02)

PART 1 - GENERAL

1.1 SUMMARY

A. Sections Includes:

1. Linear wood ceiling system in linear baffle configuration.
2. Mounting and suspension system.

1.2 SYSTEM REQUIREMENTS

- A. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, wet work i.e. gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.3 SUBMITTALS

A. Product Data: Submit following:

1. Product data for wood species and cut, suspension, and mounting system.

B. Shop Drawings:

1. Submit plans, elevations, sections, and details showing suspension and mounting systems, dowels, splines, and related requirements. Show coordination with lighting, HVAC, fire and other items that may penetrate the ceiling, blocking and reinforcing.

- C. Samples: Submit 3/4 by 12 by 12 inch sample panels showing color, texture, and finish.

D. Certifications:

1. Submit fabricator's certification that products furnished for Project meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility:

1. Furnish each product from one manufacturer, unless otherwise acceptable to Architect.
2. Provide ceiling system as complete unit, including suspension and accessory items necessary for proper installation.

- B. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum five years' experience.

- C. Installer Qualifications: Installers shall have at least 15 years of experience installing custom wood ceilings. Provide proper proof of project histories with these products.

1.5 FIELD SAMPLES

- A. Sample Installation: Construct sample panel 4 feet long by 4 feet wide as directed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store the wood veneer ceiling panels in a dry interior location in their cartons prior to installation to avoid damage. Store the ceiling panel cartons in a flat, horizontal position. Do not remove the protectors between the panels until installation.
- B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Do not expose the wood veneer ceiling panels to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.
- C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.7 PROJECT CONDITIONS

- A. Prior to installation, the wood veneer ceiling materials are required to reach room temperature and have stabilized moisture content for a minimum of 72 hours.
- B. Do not install the wood veneer panels in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.
- C. As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Finishes Legend or comparable product with approved substitution request by one of the following:
 - 1. Architectural Components Group Inc.
 - 2. Rulon International
 - 3. 9wood
 - 4. Norton Industries, Inc.
 - 5. Geometrik

2.2 WOOD GRILLE CEILING PANELS (WLC)

- A. Basis of Design: 9 Wood 1100 Cross Piece Grille. Subject to compliance with requirements, other products may be considered in accordance with Section 01 25 13 – Product Substitution Procedures.
 - 1. Wood Panels: (WLC-1)
 - a. Species: Solid Western Hemlock.
 - b. Member Size: 5/8" w x 2-1/4" d x 10' panel length.
 - c. Edge Profile: Square
 - d. Reveal: 1" at abutting panels
 - e. Members/LF: 5 Members/LF
 - f. Assembly Style: Heavy duty 15/16" T-Rail system
 - g. Fire Rating: Class 1 (A) Fire Rating

- h. Finish: See 09 00 01 Finishes Legend
- i. Acoustic Backer: Non-woven black acoustic fabric
- j. Perimeter trim: Solid Western Hemlock vertical return trim, see detail for size; stained to match WLC-1.

- B. NAUF: If veneer, substrate material shall be manufactured with no added urea formaldehyde.
- C. Attachment System: System shall be suspended according to manufacturer's suggested method of suspension as per the design details provided in the plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with work in accordance with manufacturer's instructions.
- B. Do not proceed with installation until all wet work such as concrete and painting has been completed and thoroughly dried out.
- C. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.
- D. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.2 INSTALLATION

- A. Linear Wood Ceiling: Install in accordance with ASTM C636, CISCA Seismic Guidelines, approved Construction Drawings and with manufacturer's installation instructions.
- B. Install plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction and adjacent surfaces.
- C. Install wall moldings at intersection of suspended ceiling and vertical surfaces.

3.3 REPAIR

- A. Surfaces: Repair wood surfaces damaged due to shipping, handling, storage, and installation. Match Architect approved sample.

3.4 CLEANING

- A. Cleaning: Clean as recommended by manufacturer. Do not use materials or methods which may damage finished surfaces or surrounding construction.

3.5 PROTECTION

- A. Protection: Protect finished work from damage due to construction operations.

END OF SECTION 09 54 26

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SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories & transition strips.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.

1.4 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. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS (RB)

2.1 THERMOPLASTIC-RUBBER BASE (RB)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allstate Rubber Corp.
 - 2. American Biltrite.
 - 3. Armstrong World Industries, Inc.
 - 4. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - 5. Flexco.
 - 6. Johnsonite; A Tarkett Company.
 - 7. Mondo America Inc.
 - 8. Nora Systems, Inc.
 - 9. Roppe Corporation, USA.
 - 10. VPI Corporation.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
 - 1. Group: I (solid, homogeneous) or II (layered).
 - 2. Style and Location:
 - a. Style B, Cove.
- C. Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (102 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: As indicated on Finish Legend, Section 09 00 01.

2.2 RUBBER MOLDING ACCESSORY AND TRANSITION STRIPS (TS)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Roppe Corporation, USA.
 - 2. VPI Corporation.
- B. Description: Rubber reducer strip for resilient flooring, joiner for tile and carpet, and transition strips.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide rubber molding accessories in areas indicated.
- E. Colors and Patterns: As indicated on Finish Legend, Section 09 00 01.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.
- D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches (152 mm) in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches (152 mm) in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.

- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply two coat(s).
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

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SECTION 09 65 43

LINOLEUM FLOOR COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Refer to Division 1 Section "Sustainable Design Requirements" WSSP for Schools for submittal requirements and format.

1.2 SUMMARY

- A. Section Includes:
 - 1. Linoleum sheet flooring.
- B. Related Sections:
 - 1. Division 9 Section "Resilient Wall Base and Accessories" for resilient base, reducer strips, and other accessories installed with linoleum floor covering.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch (152-by-230-mm) sections of each color and pattern of floor covering required.
- D. Product Schedule: For floor covering. See Finish Legend for product description.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor covering to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sheet Flooring: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each color, pattern, and type of sheet flooring installed.
 - 2. Boxes are to be marked with campus building name and number and room number. Obtain a receipt when delivered to the College and furnish receipt at project closeout.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
 - 2. Engage a flooring technician certified by manufacturer for first two days of installation to oversee.
 - 3. Maintenance training with linoleum manufacturer specialist will take place after installation is complete.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 90 deg F (32 deg C).
 - 1. Sheet Flooring: Store rolls upright.

1.9 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor coverings during the following time periods:
 - 1. 72 hours before installation.
 - 2. During installation.
 - 3. 72 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 72 hours after floor covering installation.

- E. Install floor coverings after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Basis of Design: Forbo Flooring, Inc. Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Tarkett Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Linoleum shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 LINOLEUM FLOOR COVERING

- A. Sheet Flooring: ASTM F 2034, Type I, linoleum sheet with backing.
 - 1. Roll Size: In manufacturer's standard length by not less than **78 inches (1980 mm)** wide.
- B. Seaming Method: Non-welded; underscribed seams.
- C. Thickness: **0.10 inch (2.5 mm)**.
- D. Colors and Patterns: See Finish Legend.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-based mastik recommended by manufacturer to suit products and substrate conditions indicated.
 - 1. Adhesives shall have zero VOC g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)** in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor coverings until they are same temperature as space where they are to be installed.
 - 1. Move floor coverings and installation materials into spaces where they will be installed at least 72 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for installing floor coverings.

- B. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.
- C. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.
- D. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on subfloor. Use chalk or other nonpermanent marking device.
- E. Install floor coverings on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of floor covering installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.
- F. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate net fit to produce a completed installation without gaps, fullness, open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections. Place into net adhesive and roll immediately with hard seam roller.
- G. Non-Welded Seams: Comply with ASTM F 1516. Underscribe and finish seams to produce surfaces flush with adjoining floor covering surfaces.

3.4 LINOLEUM SHEET FLOORING INSTALLATION

- A. Unroll sheet floorings and allow them to stabilize before cutting and fitting.
- B. Lay out sheet floorings as follows:
 - 1. Maintain uniformity of floor covering direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least **6 inches (152 mm)** away from parallel joints in floor covering substrates.
 - 3. Match edges of floor coverings for color shading at seams.
 - 4. Avoid cross seams.
 - 5. Eliminate deformations that result from hanging method used during drying process (stove bar marks).

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
- B. Perform the following operations immediately after completing floor covering installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover floor coverings until Substantial Completion.

END OF SECTION 09 65 43

SECTION 09 68 13

TILE CARPETING

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 modular carpet tile.
- B. Related Requirements:
 - 1. Section 09 65 13 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.

7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

F. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II or Master II certification level.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups at locations and in sizes shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.10 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE CPT-1, CPT-2, CPT-3

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. J&J Flooring Group.
 2. Mannington Mills, Inc.
 3. Patcraft; a division of Shaw Industries, Inc.
 4. Shaw Contract Group; a Berkshire Hathaway company.
 5. Tandus; a Tarkett company.
 6. Mohawk Group.
- B. Basis of Design: Shaw Contract Group
1. See Finish Legend 09 00 01 for patterns / color.
- C. Single Source Responsibility: Obtain all of each different materials from a single manufacturer.
- D. (CPT-1, CPT-2, CPT-3); Shaw: Active Collection. Patterns / color as indicated in Finish Legend 09 00 01.
1. Description:
 - a. Construction: Multi-level pattern loop
 - b. Gauge: 1/12"
 - c. Stitches per Inch: 9.0 – 9.5 (pattern dependent)
 - d. Weight: 20.0 oz/yd²
 - e. Pile Height Average: .073" - .082" (pattern dependent)
 - f. Fiber Content: Eco Solution Q
 - g. Size: 12" x 48"
 - h. Install Method: See Finish Legend
 - i. Protective Treatments: SSP Shaw soil protection
 - j. Dye Method: 100% Solution dyed.
 - k. Backing: Ecoworx Tile
 - l. Adhesive System: As recommended by manufacturer
 - m. Flooring Radiant Panel (ASTM E-648) : Class I
 - n. Test Smoke Density (ASTM E-662) Flaming: Mean Average – 450 Max.
 - o. Flammability: (CPSC FF1-70): Passes
 - p. Electrostatic Propensity (AATCC 134) : ≤ 3.5 kv

2.2 STALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation. Retain "Metal Edge/Transition Strips" Paragraph below unless resilient edge strips for carpet tile are specified in Section 09 65 13 "Resilient Base and Accessories." If retaining, revise to suit Project and indicate width requirements on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 03 30 00 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - b. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.

- D. Maintain pile-direction patterns indicated on Drawings.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 09 72 00

WALL COVERINGS

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. Dry Erase wallcovering (VWC-1).
 - 2. Custom digital graphic vinyl wallcovering (VWC-2).
- B. Related Sections:
 - 1. Division 09 Section "Painting" for priming wall surfaces.
 - 2. Division 01 Section "Alternates" for additional VWC.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate seams and termination points.
- C. Samples for Verification: Full width by 36-inch- (914-mm-) long section of wall covering.
 - 1. Sample from same flitch to be used for the Work, with specified finish applied.
 - 2. For custom graphic will require sample of full size portion of graphic as well as overall layout at small scale.
- D. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wall-Covering Materials: For each type, full-size units equal to 5 percent of amount installed.

1.7 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire-Growth Contribution: Textile wall coverings tested according to NFPA 265 and complying with test protocol and criteria in the 2003 IBC.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 WALL COVERINGS

- A. General: Provide rolls of each type of wall covering from same print run or dye lot.

2.2 DRY ERASE WALLCOVERING (VWC-1)

- A. Flexible dry erase surface: Supported vinyl material with 1 mil thick PVC film with thermally activated adhesive:
- B. Total Weight: 14.75 oz./sq. yd.
- C. Width: 60".

- D. Backing: 50% Polyester, 50% cotton.
- E. Finish: Solvent and abrasion resistant.
- F. Colors/Textures/Patterns: See Finish Legend 09 00 00.
- G. Fire Rating: Class A.
- H. Installation: Level 5 finish; installation per manufacturer's recommendations.

2.3 CUSTOM DIGITAL GRAPHIC VINYL WALLCOVERING (VWC-2)

- A. Vinyl wallcovering standards: Provide mildew resistant products complying with the following:
 - 1. Products: Subject to compliance with requirements. Provide the following:
 - a. See Finish Legend 09 00 00.
- B. Total weight excluding coatings: 20 oz/lin. yd.
- C. Width: 54".
- D. Backing: Osnaberg fabric.
 - 1. Fiber content: Woven poly.
- E. Substrate: Suede flexible substrate.
- F. Repeat: None. Custom graphic has already been given to the manufacturer.
 - 1. Reference MDC Project No. 38597.
- G. Installation: Level 5 Finish; installation method per manufacturers recommendation.

2.4 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.
 - 1. Adhesive shall have VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Primer/Sealer: Mildew resistant, complying with requirements in Division 09 Section "Interior Painting" or as recommended in writing by wall-covering manufacturer for intended substrate.
- C. Metal Primer: Interior ferrous metal primer complying with Division 09 Section "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 3. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 4. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION

- A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated except where more stringent requirements apply.
- B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
- D. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- E. Match pattern 72 inches (1830 mm) above the finish floor.

- F. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 6 inches (150 mm) from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- H. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

3.4 CLEANING

- A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 72 00

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SECTION 09 91 13
EXTERIOR PAINTING

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 the following exterior substrates:
 - 1. Concrete.
 - 2. Steel and iron.
 - 3. Galvanized metal.
 - 4. Wood.
- B. Related Section:
 - 1. Section 07 92 00 "Joint Sealant" for caulking of interior joints at or adjacent to surfaces to be painted.
 - 2. Section 09 91 23 "Interior Painting."

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 D 523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit data sheet for each coating proposed. Include preparation requirements and application instructions.

1. Identify the following characteristics for each product submitted:
 - a. Solids by Volume
 - b. Resin Base
 - c. Sheen
 - d. VOC content
2. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Label each Sample for location and application area to indicate materials, color, sheen, DFT of each coat applied, and total system DFT.

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 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products listed in the Exterior Painting Schedule for the paint category indicated, from one of the following manufacturers:

1. BEHR Paints
2. Benjamin Moore
3. PPG
4. Rodda

5. Sherwin Williams

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- 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.
 - 3. Test compatibility of existing coatings, including shop applied primers and previously applied coatings on existing surfaces scheduled to be recoated, by applying specified coating system to small, inconspicuous area.
 - 4. If specified coating lifts or blisters existing coating, apply barrier or tie coat as recommended by coating manufacturer.
 - 5. If no compatible barrier or tie coat exists, remove existing coating completely and apply coating system as specified for new work.
- C. Colors: Refer to Section 09 00 01 Finishes Legend.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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. Fiber-Cement Board: 12 percent.
 3. Masonry (Clay and CMUs): 12 percent.
 4. Wood: 15 percent.
 5. Portland Cement Plaster: 12 percent.
 6. Gypsum Board: 12 percent.
- C. Prior to applying alkali and acid sensitive coatings, test surface pH with universal pH paper placed against wetted surface. Substrate pH shall not exceed pH of clean wash water.
- 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.
- F. Allow surface to dry completely after preparation of surfaces and prior to application of finish coating systems.

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.
- 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 existing coatings, 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. Use one of the following methods to prepare surface to receive new coating:
1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
 2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- E. Masonry Substrates: Remove efflorescence and chalk, oil, grease and stains. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates Not Shop Primed: 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 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
1. Apply specified primer to encapsulate bare steel or previously primed steel surfaces where primer has been scratched or damaged.
- H. Galvanized-Metal Substrates: Remove soluble and insoluble contaminants and corrosion. Sweep (Abrasive) Blasting per ASTM D6386 to achieve a uniform anchor profile (1.0 - 2.0 mils).
- I. Galvanized Metal: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.
- J. Wood Substrates, Opaque:
1. Scrape and clean knots, and apply coat of sealer to knots, pitch and resinous sapwood before applying primer.
 2. Sand surfaces that will be exposed to view, and remove dust after each sanding.
 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 SURFACE PREPARATION OF PREVIOUSLY COATED SURFACES

- A. General:
1. Remove cracked and deteriorated sealants and caulking.
 2. Remove chalk deposits and loose, blistered, peeling, scaling, or crazed finish to bare base material or sound substrate by scraping and sanding.
 3. Wash surfaces with solution of TSP to remove wax, oil, grease, and other foreign material; rinse, and allow to dry. Exercise caution that TSP solution does not soften existing coating.
 4. Abrade glossy surfaces by sanding or wiping with liquid de-glosser.
 5. Remove mildew as specified above.
 6. Test compatibility of existing coatings by applying new coating to small, inconspicuous area. If new coatings lift or blister existing coatings, request recommendation from Architect.
 7. Apply specified primer to surfaces scheduled to receive coatings.
- B. Concrete, Masonry, and Portland Cement Plaster:
1. Fill cracks and voids with latex base filler.
 2. Apply masonry conditioner to masonry surfaces in accordance with manufacturer's instructions.
 3. Apply primer over bare surfaces and filler material.
- C. Gypsum Wallboard and Gypsum Plaster:
1. Fill cracks and voids with spackling compound.
 2. Apply primer over bare surfaces and newly applied texture coatings.

D. Metal:

1. Remove rust from surfaces to bare metal in accordance with SSPC SP6 "Commercial Blast Cleaning" or SP3 "Power Tool Cleaning".
2. Exercise care not to remove galvanizing.
3. Complete preparation as specified for new work.

E. Wood:

1. Fill cracks, crevices and nail holes with putty or wood filler.
2. Apply primer over bare surfaces and filler material.

3.4 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

B. 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.

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.
6. Do not apply finishes to surfaces that are improperly prepared.

C. 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.

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.

E. Prime Coats:

1. Apply initial coat to surfaces as soon as practical after preparation and before subsequent surface deterioration.
2. Backprime exterior woodwork with specified primer.
3. Apply primer to wood and metal sash before field glazing.

F. Intermediate and Top Coats:

1. Allow previously applied coat to dry before next coat is applied.
2. Sand and dust lightly between coats as recommended by coating manufacturer.

3. Apply each coat to achieve uniform finish, color, appearance, and coverage free of brush and roller marks, runs, misses, visible laps or shadows, hazing, bubbles, pin holes, or other defects.
4. If stains, undercoats, or other conditions show through final topcoat, correct defects and apply additional topcoats until coating film is of uniform finish, color, and appearance.

3.5 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.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 1. Split Face Block.
 2. Latex System MPI EXT 3.1A :
 - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.
- B. Steel and Iron Substrates (columns, beams and joists - not handrails or hollow metal doors and frames):
 1. Water-Based Light Industrial Coating System; MPI EXT 5.1C (over alkyd primer):
 - a. Prime Coat: Primer, alkyd, anti-corrosive for metal, MPI #79.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.
 2. Water-Based Light Industrial Coating System MPI EXT 5.3J: Hollow metal doors and frames
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

- c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

END OF SECTION 09 91 13

SECTION 09 91 23

PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation, painting and finishing of exposed interior and exterior items and surfaces as defined in the Master Painters Institute (MPI) Architectural Painting Manual and the following:
 - 1. Surface preparation, priming and finish coats specified in this Section are in addition to shop-priming and surface treatment specified under other Sections.
 - 2. Special Preparation and repainting of existing surfaces.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Operation & Maintenance Data" for required product information for manuals.
 - 2. Division 7 Section "Sealants" for caulking of interior joints at or adjacent to surfaces to be painted.
 - 3. Division 5 Section, "Metal Fabrications" for shop-priming ferrous metal.
 - 4. Division 8 Section, "Steel Door and Frames" for shop-priming steel doors and frames.
 - 5. Division 9 Section "Wall Coverings" priming gypsum board that receives VWC.
- C. Paint exposed surfaces whether or not colors are designed in schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.
 - 1. Painting does not include field-painting exposed bare and covered pipes and ducts, hangers, exposed steel and iron work and primed metal surfaces of mechanical and electrical equipment unless specifically indicated.
- D. Painting is not required on prefinished items (except as noted), finished metal surfaces, concealed surfaces, operating parts and labels.
 - 1. Prefinished items not to be painted include the following factory-finished components:
 - a. Plastic laminated architectural casework.
 - b. Finished mechanical and electrical equipment.
 - c. Light fixtures.
 - d. Switchgear.
 - e. Distribution cabinets.
 - f. Prefinished toilet compartments.

2. Concealed surfaces not to be painted include wall or ceiling surfaces in inaccessible areas.
3. Finished metal surfaces not to be painted include:
 - a. Anodized aluminum
 - b. Stainless steel and Chromium plate.
 - c. Copper, bronze and brass
4. Operating parts not to be painted include moving parts of operating equipment such as the following:
 - a. Valve and damper operators
 - b. Linkages
 - c. Sensing devices
 - d. Motor and fan shafts
5. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating or nomenclature plates.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each paint system specified, including block fillers and primers.
 1. Provide the manufacturer's technical information including label analysis and instructions for handling, storage and application of each material proposed for use.
 2. List each material and cross-reference the specific coating, finish system and application. Identify each material by the manufacturer's catalog number and general classification.
 3. Submit Material Safety Data Sheets to Owner's Representative at least two weeks before material is delivered to the site.
- C. Samples for Verification Purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions on representative samples of the actual substrate.
 1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color and texture are achieved.
 2. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.
 3. Submit samples on the following substrates for the Architect's review of color and texture only.
 - a. Gypsum Board: Submit two 8-inch-square samples for each color and finish.
 - b. Painted Wood: Submit two 12-inch square samples of each color and material on hardboard.
 - c. Ferrous Metal: Submit two 4-inch-square samples of flat metal and two 8-inch-long samples of solid metal for each color and finish.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.
- B. Single-Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.
- C. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.
- D. Paint Grade: 'Premium' as defined by the MPI.
- E. Employ only qualified journeymen in this painting and decorating work; apprentices may be employed on the project to work under the direction of qualified journeymen.
- F. Conform to the standards contained in the Master Painters Institute Architectural Painting Specification Manual, latest edition (hereafter referred to as MPI Painting Specification Manual) for all painting products including preparation and application of materials. MPI Painting Specification Manual as issued by the local MPI Accredited Quality assurance Association having jurisdiction.
- G. All paint manufacturers and products used shall be as listed under the "Approved Products" section of the MPI Architectural Painting Specification Manual.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packaged and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type)
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing and application.

1.6 JOB CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).

- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperature are between 45 deg F (7 deg C) and 95 deg F (35 deg C).
- C. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.
- D. Do not proceed with any work under this Section unless a lighting level of a minimum of 15 candlepower per square foot is provided on the surfaces to be finished.

1.7 EXTRA STOCK

- A. For the Owner's maintenance purposes for touch up, furnish one properly filled, labeled and sealed gallon can of each type of finish coat of each color taken from the batch mix furnished for the work. Turn over to the Owner's representative at completion of the painting work. Obtain receipt to include in close-out documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. All materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) shall be in accordance with the MPI Architectural Painting Specification Manual "Approved Product" listing and shall be from a single manufacturer for each system used.
- B. Other paint materials such as linseed oil, shellac, etc. shall be the highest quality product of an approved manufacturer listed in the MPI Architectural Painting Specification Manual and shall be compatible with other coating materials as required.
- C. All materials and paints shall be lead and mercury free and shall have low VOC content where possible.
- D. Manufacturer: Provide products according to the manufacturer and product identification listed in the Finishes Legend. Subject to conformance with requirements and properties of the products listed, products of the following manufacturers will be considered.
 - 1. Benjamin Moore & Co. (Moore)
 - 2. Columbia Paint Co. (Columbia)
 - 3. Fuller (Fuller)
 - 4. Glidden Professional (Akzonobel).
 - 5. Parker Paint Mfg. Company (Parker)
 - 6. PPG Industries, Pittsburgh Paints (PPG)
 - 7. Rodda Paint Co. (Rodda)
 - 8. The Sherwin-Williams Company (S-W)
 - 9. ICI Paint.
 - 10. Kelly Moore Paint

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, finish coat materials and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.
- B. Material Quality: Provide the manufacturer's product as specified. Paint material containers not displaying manufacturer's product identification shall not be brought to the job site.
- C. Paints shall comply with Green Seal Standard GS-11 points.
- D. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:
 - 1. Flat Paints and Coatings: VOC not more than 50 g/L.
 - 2. Non-Flat Paints and Coatings: VOC not more than 150 g/L.
 - 3. Anti-Corrosive Coatings: VOC not more than 250 g/L.
 - 4. Varnishes and Sanding Sealers: VOC not more than 350 g/L.
 - 5. Stains: VOC not more than 250 g/L.
 - 6. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 7. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1, 2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.

2.3 COLOR SCHEDULE

- A. Where colors are identified by product names and numbers, provide perfect color match to the listed colors. "P" numbers refer to color identification in the Finishes Legend included in the Finish Schedule at the end of this Section.

2.4 GLOSS

- A. MPI Gloss and Sheet Standards are now as follows:

	Gloss @ 60°	Sheen @ 85°
1. Gloss Level 1: A traditional matte finish – flat	Max. 5 units	Max. 10 units
2. Gloss Level 2: A high side sheen flat–‘a velvet-like’ finish	Max. 10 units	10 – 35 units
3. Gloss Level 3: A traditional ‘eggshell-like’ finish	10 – 25 units	10 – 35 units

4.	Gloss Level 4: A 'satin-like' finish	20 – 35 units	Min. 35 units
5.	Gloss Level 5: A traditional semi-gloss	35 – 70 units	
6.	Gloss Level 6: A traditional gloss	70 – 85 units	
7.	Gloss Level 7: A high gloss	More than 85 units	

2.5 PAINT SCHEDULE

- A. Exterior Surfaces: Paint exterior surfaces in accordance with the following MPI Architectural Painting Specification Manual requirements:
1. Structural Steel & Metal Fabrications:
 - a. EXT 5.1N: W. B. Light Industrial Coating (over epoxy primer).
- B. Interior Surfaces: Paint interior surfaces in accordance with the following MPI Architectural Painting Specification Manual requirements:
1. Metal Fabrications: For steel exposed to view.
 - a. INT 5.1B: High performance acrylic (Gloss Level 5) finish.
 2. Galvanized Metal: Doors, frames, miscellaneous steel.
 - a. INT 5.3B: High performance acrylic (Gloss Level 5) finish.
 3. Dressed Lumber, Plywood, and MDF: Including trim, casings, etc.
 - a. INT 6.3A: Latex (Gloss Level 4) finish.
 4. Gypsum Board: Gypsum wallboard, drywall, "sheet rock type material," etc.
 - a. INT 9.2B: High performance acrylic (Gloss Level 3, except in Toilet Rooms, Custodial Rooms and Electrical Room where Level 5 is required. Gloss Level 2 at ceilings except for Gloss Level 5 where Gloss Level 5 is required on walls) finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
1. Do not begin to apply paint until unsatisfactory conditions have been corrected.
 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures and similar items already installed that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items, if necessary, to completely paint the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatment, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to the manufacturer's instructions for each particular substrate condition and as specified.
 1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing about anticipated problems using the specified finish-coat material with substrates primed by others.
 2. Wood: Clean surfaces of dirt, oil and other foreign substances with scrapers, mineral spirits and sandpaper as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain or seal wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides and backsides of wood including cabinets, trim, counters, cases and paneling.
 - c. When transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster or other wet wall construction occurs on backside.
 - e. Seal tops, bottoms and cutouts of primed or unprimed wood doors with a heavy coat of varnish, primer or sealer immediately upon delivery.
 3. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC).
 - a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.
 4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
 5. Cementitious Materials: Prepare concrete, cement plaster and reinforced concrete panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by the coating manufacturer.

- b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish coating to blister and burn, correct this condition before coating application. Do not paint surfaces where moisture content exceeds that permitted in the manufacturer's printed directions.

3.3 ADDITIONAL REQUIREMENTS FOR EXISTING SURFACES SCHEDULED FOR REPAINT

- A. General: Reference is made to the MPI Architectural Painting Specification Manual for the terminology used to describe the existing conditions. This information is not intended to permit or encourage the Bidder/Contractor to forgo site visits and inspections to determine actual conditions before the Contract is awarded.

3.4 MATERIALS PREPARATION

- A. General: Carefully mix and prepare paint materials according to manufacturer's directions.
 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials or residue.
 2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
 3. Use only thinners approved by the paint manufacturer and only within recommended limits.
- B. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.5 APPLICATION

- A. General: Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces or conditions detrimental to formation of a durable paint film.
 1. Paint surface treatments and finishes are indicated in the schedules.
 2. Provide finish coats that are compatible with primers used.
 3. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coats has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.
 4. Apply additional coats if undercoats, stains or other conditions show through final coat of paint until paint film is of uniform finish, color and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 5. The term exposed surfaces includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles and similar components are in place. Extend coating in these areas, as required, to maintain the system integrity and provide desired protection.

6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
 8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 9. Omit primer on metal surfaces that have been shop-primed and touch-up painted.
 10. Paint unfinished wood cleats, underside of casework, desk tops and similar items.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- D. Application Procedures: Apply paints and coatings by brush, roller, spray or other applicators according to the manufacturer's directions and requirements of the surface to be painted.
1. Brushes: Use brushes best suited for the material applied.
 2. Rollers: Use rollers of carpet, velvet back or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size and recommended by the manufacturer for the material and texture required.
- E. Minimum Coating Thickness: Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of not less than 4.0 mils for the entire system of prime and finish coats for three coat work, or 2.5 mils where two coat work is specified.
- F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime-coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- G. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks or other surface imperfections.
- H. Pigmented (Opaque) Finishes: Completely cover to provide a smooth, opaque surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.
- I. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not complying with specified requirements.
- 3.6 CLEANING
- A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.7 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing and repainting as acceptable to the Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 09 91 23

SECTION 09 93 00

STAINING AND TRASPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of wood stains and transparent finishes on the following substrates:
 - 1. Interior Substrates: Dressed lumber (finish carpentry or woodwork).
- B. Related Sections:
 - 1. Section 01 23 00 "Alternates" for alternates affecting transparent finish system for interior woodwork.
 - 2. Section 06 40 23 "Interior Finish Carpentry" for Architect's control sample of wood finish.
 - 3. Section 08 52 00 "Clad Wood Windows and Hinged Doors" site finishing.
 - 4. Section 09 46 00 "Wood Flooring" for site finishing of wood flooring.
 - 5. Section 09 91 23 "Interior Painting" for opaque finishes.

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 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.
- B. Samples: For each type of finish system and in each color and gloss of finish required.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of stain color selections will be based on mockups.
 - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in wood finish systems schedules for the product category indicated.

2.2 MATERIALS, 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 manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Stain Colors:
 - 1. As indicated in Section 09 00 01 Finishes Legend.
 - 2. Match Architect's control sample as approved per Section 06 40 23 Interior Architectural Woodwork.

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 Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- C. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with finish application only after unsatisfactory conditions have been corrected.
 - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

A. Wood Substrates: Wood trim, architectural woodwork, and wood windows.

1. Water-Based Varnish over Stain System MPI INT 6.3WW:

- a. Stain Coat: Stain, semitransparent, for interior wood, MPI #186.
- b. Intermediate Coats (2) and Topcoat: Varnish, water based, clear, semi-gloss (MPI Gloss Level 5), MPI #129.

2. Clear, Two-Component Polyurethane System MPI INT 6.1W:

- a. Prime Coat: Two-component polyurethane matching topcoat.
- b. Intermediate Coat: Two-component polyurethane matching topcoat.
- c. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or MPI Gloss Level 7), MPI #78.

END OF SECTION 09 93 00

SECTION 10 11 00

VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Visual display board assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- B. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Show locations of panel joints. Show locations of field-assembled joints for factory-fabricated units too large to ship in one piece.
 - 3. Show locations and layout of special-purpose graphics.
 - 4. Include sections of typical trim members.
 - 5. Include wiring diagrams for power and control wiring.
- C. Samples for Verification: For each type of visual display unit indicated.
 - 1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
 - 2. Trim: 6-inch long sections of each trim profile.
 - 3. Display Rail: 6-inch long section of each type.
 - 4. Accessories: Full-size Sample of each type of accessory.
- D. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of tackboards.
- C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For visual display units to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.9 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 50 years from date of Substantial Completion.
 - 3. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

2.3 VISUAL DISPLAY BOARD ASSEMBLY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Best-Rite; MooreCo, Inc.
 - 2. Claridge Products and Equipment, Inc.
 - 3. Ghent Manufacturing, Inc.
 - 4. Greensteel, Inc.
 - 5. Lemco, Inc.
 - 6. PBS Supply, Inc.
 - 7. Nelson Adams Company
- B. Visual Display Board Assembly: Factory fabricated.
 - 1. Assembly: Markerboard.
 - 2. Corners: Square.
 - 3. Width: As indicated on Drawings.
 - 4. Height: As indicated on Drawings.
 - 5. Mounting Method: Direct to wall.
- C. Markerboard Panel: Porcelain-enamel-faced, projection friendly steel markerboard panel on core indicated.
 - 1. Color: White.
 - 2. Core: 3/8-inch (9.5 mm) thick, particleboard core material complying with requirements of ANSI A208.1, Grade 1-M-1.
 - 3. Backing Sheet: 0.018-inch (0.46 mm) thick, galvanized steel sheet backing.
 - 4. Laminating Adhesive: Manufacturer's standard, moisture-resistant, thermoplastic type adhesive.
- D. Tackboard Panel: Natural Cork.
 - 1. Color and Pattern: Natural Cork.
- E. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch thick, extruded aluminum; standard size and shape.

1. Aluminum Finish: Clear anodic finish.
- F. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
- G. Chalktray: Manufacturer's standard; continuous.
1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
- H. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops designed to hold accessories.
1. Size: 2 inches high by full length of visual display unit.
 2. Map Hooks: Two map hooks for every 48 inches of display rail or fraction thereof.
 3. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches of display rail or fraction thereof.
 4. Flag Holder: One for each marker board/visual display unit.
 5. Tackboard Insert Color: Match Architect's sample.
 6. Aluminum Color: Match finish of visual display assembly trim.
- I. Special-Purpose Graphics: Fuse or paint semi-visible writing guidelines or music staff lines or grid, 1 inch square graphic onto surface of porcelain-enamel visual display unit, in locations indicated.

2.4 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
1. Face Sheet Thickness: 0.021 inch uncoated base metal thickness.
 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 3. Medium-Density Fiberboard Core: 7/16 inch thick; with manufacturer's standard moisture-barrier backing.
 4. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.5 TACKBOARD PANELS

- A. Tackboard Panels:
1. Facing: Vinyl fabric factory laminated to 1/4-inch thick cork sheet.
 2. Core: Manufacturer's standard.

2.6 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto

fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.

- C. Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II,; weighing not less than 13 oz./sq. yd.; with surface-burning characteristics indicated.
- D. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

2.7 GENERAL FINISH REQUIREMENTS

- 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 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-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
 - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
 - 2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- C. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.
- D. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings.
- E. Display Rails: Install rails at mounting heights indicated on Drawings. Attach to wall surface with fasteners at not more than 16 inches o.c.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 10 11 00

SECTION 10 44 13
FIRE-EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Includes:
 - 1. Fire-protection cabinets.
 - 2. Fire-protection accessories.
- B. Related Sections:
 - 1. Section 10 44 16 "Fire Extinguishers".

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
 - 1. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Verification: For each type of exposed cabinet finish required, prepared on samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 1. Size: 6-by-6-inch- (150-by-150-mm-) square samples.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Fire-Protection Cabinets (Basis of Specification – Larsen's Manufacturing Co. "Architectural Series" semi-recessed AL 2409-6R (FEC-1):
 - a. J.L. Industries, Inc.
 - b. Larsen's Manufacturing Company.
 - c. Potter-Roemer; Div. of Smith Industries, Inc.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 366/A 366M, commercial quality, stretcher leveled, temper rolled.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
1. Sheet: ASTM B 209 (ASTM B 209M).
 2. Extruded Shapes: ASTM B 221 (ASTM B 221M).

2.3 FIRE-PROTECTION CABINETS

- A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
1. Cabinet Metal: Aluminum sheet.
 2. Shelf: Same metal and finish as cabinet.
- B. Cabinet Type: Suitable for the following:
1. Fire extinguisher.
- C. Cabinet Mounting: Suitable for the following mounting conditions:
1. Semirecessed: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated.
- D. Cabinet Trim Style: Fabricate cabinet trim in one piece with rolled edges.
1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - a. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Manufacturer's standard, as follows:

1. Aluminum sheet.

F. Door Material: Manufacturer's standard, as follows:

1. Aluminum sheet.

G. Door Glazing: Manufacturer's standard, as follows:

1. Clear Float Glass: ASTM C1036, Type 1, Class 1. Quality 3mm thick.

H. Door Style: Manufacturer's standard design, as follows:

1. Vertical duo panel with frame.

I. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.

1. Provide minimum 1/2-inch- (13-mm-) thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
2. Provide inside latch and lock for break-glass panels.

J. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

2.4 ACCESSORIES

A. Break-Glass Strike: Provide manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.

B. Door Locks:

1. Locks for fire extinguisher cabinets shall be Series 3000 disc tumbler cam locks as manufactured by the Fort Lock Corporation of Elk Grove, Illinois, (708) 456-1100, and available from KDL Hardware Supply, 1621 Eighth Avenue, Seattle, Washington 98111, (800) 926-7716. Specific lock may be #C- 23058-LA-CA-2K BF 1816-9 or similar as required by the cabinet. Lock & Supply, 4304 S. 131st St. Place, Seattle, WA 98168 and Allied Safe & Lock in Spokane.
2. Fire extinguisher cabinets are to be installed with the inside top of box at 5'-0" above finish floor. Locks shall be keyed to a 54G200 key. Provide two keys for each lock. These locks are also available from American.

C. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.

1. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.
 - a. Application Process: Silk-screened.
 - b. Lettering Color: Red.
 - c. Orientation: Vertical.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: Nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets are to be installed.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing fire-protection specialties.
- B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
 - 1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
 - 2. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust cabinet doors that do not swing or operate freely.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10 44 13

SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Division 1 Section "Sustainable Design Requirements – WSSP for Schools" for submittal requirements and formats.

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Sections:
 - 1. Section 10 44 13 "Fire Extinguisher Cabinets".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. Ansul Incorporated; Tyco International Ltd.
 - c. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - d. Larsen's Manufacturing Company.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Red Steel Tank, MP Series – Multi-Purpose Dry Chemical Type (typical) (FE-1): 4A-80B:C, 10-lb UL rated nominal capacity, Model MP-10, manufactured by Larsen's Manufacturing Co., with pressure gage.

2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amerex Corporation.
 - b. Buckeye Fire Equipment Company.
 - c. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - d. Larsen's Manufacturing Company.
 - e. Potter Roemer LLC.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 44 16

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SECTION 10 50 00

MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Corner guards.
 - 2. Glass Film.
 - 3. Poster Display.
 - 4. Decorative surface vinyl finish
- B. Related Sections include the following:
 - 1. Division 9 Section "Gypsum Board Assemblies" for backing and blocking for surface mounted items and equipment.

1.3 SUBMITTALS

- A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.
 - 1. Product data for specified items including rough-in dimensions, details showing mounting methods, relationships to surrounding construction, hardware, and materials.
 - 2. Shop drawings showing fabrication and installation of customized access doors and frames, including details of each frame type, elevations of door design types, anchorage and accessory items.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Specification is based on the products listed. Subject to compliance with requirements and properties of the products listed, products by other manufacturers will be considered if submitted in accordance with the stipulations in the Invitation for Subcontractor Bids.

2.2 CORNER GUARDS

- A. Manufacturer: Korogard: Anodized Aluminum corner guard
 - 1. Surface Mount (CG-1):

- a. Material: 1/16" thick Anodized Aluminum. See Finish Legend for finish.
- b. Size: 1-1/2" (38mm) wing.
- c. Mounting: Adhered.
- d. Height: Custom height; see drawings.
- e. Radius: 1/32".

2.3 GLASS FILM (FILM-1)

- A. Manufacturer: Decorative Films; Solyx.

1. Pattern: See Finish Legend.
2. Location: Occurs at office side at locations noted in Int. Elevations.
3. Film Type: Vinyl.
4. Thickness: 4 mil.
5. Adhesive: Clear; pressure sensitive.
6. Class A Fire rating.
7. Install: Per manufacturer's recommendation.

2.4 POSTER DISPLAY

- A. Manufacturer: Nova Display Systems #KASP-010.

1. Acrylic frameless poster display kit.
2. Size: (3) 30" x 40".
3. 1/4" thick clear back and 1/8" non-glare front acrylic panels – with holes for mounting.
4. Includes standoffs and hardware for mounting.

2.5 DECORATIVE SURFACE FINISH (FILM-2)

- A. Manufacturer: 3M: DI-NOC Architectural Vinyl finish – Wood Grain.

1. Material : 8 mil. vinyl
 - a. Pattern: See Finish Legend
2. Installation direction: per manufacturer's recommendation
3. Self-adhering pressure sensitive
4. Class A fire rated
5. Location: at ceiling; See RCP

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

- A. Follow manufacturer's printed instructions for installation.
- B. Locate as indicated, or if not indicated, as directed.

3.2 ADJUST AND CLEAN

- A. Adjust Specialties having operating features after installation for proper operation.
- B. Remove and replace specialties that are damaged.

END OF SECTION 10 50 00

SECTION 12 24 13

ROLLER WINDOW SHADES (ALT. 03)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Division 1 Section "Sustainable Design Requirements – WSSP for Schools" for submittal requirements and formats.
- C. Section Includes:
 - 1. Manually operated roller shades with single rollers
- D. Related Requirements:
 - 1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
 - 2. Section 07 92 00 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
 - 1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches (250 mm) long.
- D. Samples for Initial Selection: For each type and color of shadeband material.
 - 1. Include Samples of accessories involving color selection.
- E. Samples for Verification: For each type of roller shade.
 - 1. Shadeband Material: Not less than 10 inches (250 mm) square. Mark interior face of material if applicable.

- F. Product Schedule: Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material, signed by product manufacturer.
- C. Manufacturer's Installation Instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 3 years of experience, approved by window shade manufacturer.
- B. Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum of 3 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 WARRANTY

- A. Roller Shade Motors and Motor control systems: Manufacturer's standard non-depreciating five-year warranty.
- B. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts, or other means to reach inaccessible areas.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.
- B. Basis of Design Product: MechoShade "Soho" series with 1% openness. Subject to compliance with requirements, comparable products by one of the following may be provided:
 - 1. Draper, Inc.
 - 2. Nysan Solar Control, Inc., a Hunter Douglas Company
 - 3. Silent Gliss USA, Inc.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS (RS)

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Manufacturer's standard, except no plastic.
 - a. Loop Length: As indicated on approved Shop Drawings.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: As indicated on approved Shop Drawings.
 - 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - 1. Roller Drive-End Location: As indicated on approved Shop Drawings.
 - 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 - 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
 - 1. Jamb mount fascia and accessories (RS-1).

2. Jamb mount fascia and accessories (RS-2 – Alt .03).
- D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- E. Shadebands:
1. Shadeband Material: Light-filtering solar shade cloth.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: Refer to 09 00 01 Finish Legend.
- F. Installation Accessories:
1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches (102 mm).
 2. Endcap Covers: To cover exposed endcaps.
 3. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 6 inches (152 mm).
 - b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
 4. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
 5. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
 6. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering shade cloth: Woven fabric, stain and fade resistant.
1. Source: Roller shade manufacturer.
 2. Type: Woven polyester.
 3. Weave: Mesh.
 4. Thickness: 19 mil.
 5. Weight: 8 oz./sq. yd..
 6. Roll Width: As indicated on Drawings.
 7. Orientation on Shadeband: Railroaded.
 8. Openness Factor: 1%.

9. Color: Refer to 09 00 01 Finish Legend.

2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
 2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.
- B. Roller Shade Locations: As indicated in window-covering schedule and as indicated on Drawings.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensure roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

3.6 SCHEDULE

- A. RCP in drawings and see Alt. 03 for extents of manual roller shades at existing exterior windows within scope of work

END OF SECTION 12 24 13

PLAN REVIEW COMMENTS

Date: 11-29-19		Project No: 2019-167	Action Taken on Comments By: _____ WC Will Comply (explain how) DN Do Not Concur (explain how otherwise addressed) C
Reviewer: G. Miller		Contract No.: 2019-167 G (2-1)	
Position: DES PM		Project Title: SCC Lair Remodel, 2019 Bid Set	
Agency: CCS		Project Mgr: Gloria Miller	
		Phone: 509-389-5819	
		Email: gloria.miller@des.wa.gov	
Item No:	Dwg. Sheet/ Spec. Sect:	Comments (Reviewer)	Explanation (Architect/Engineer)
NOTE: Items below relate to the Specification.			
	Cover Sheet	Update date to revised Adv. for Bids. I will provide this to you.	
	Title Sheet	Move Title Sheet with Signatures in front of TOC. I will forward a signed title sheet for use in the specification.	
	Title Sheet	Update "Date" to the revised Adv. for Bids date. I will provide this to you.	
	Title Sheet	Add A/E signed professional license seal to sheet.	
	TOC	Add complete list of drawings following the technical specification sections.	
	TOC	Change "General Conditions" to "General and Supplemental Conditions."	
	Adv. for Bids	I'm updating the Adv. for Bids. I will forward it to the contract specialist for review. The contract specialist will send out the FINAL draft and it will replace the current placeholder in your set.	
	Dept. of L&I	Delete 24 pp. listing WA State Prevailing Wage Rates and 14 pp. of Benefit Code Keys.	
	01 23 00	Where is Alt 3 – Roller Shades called out.	

	01 79 00	Add Substantial Completion Checklist, Certificate of Substantial Completion, and Final Acceptance Checklist at back of specification section. Forms are attached for your use.	
NOTE: Items below relate to the Drawing Set.			
	Titleblock	Update date to revised Adv. for Bids date. I will provide this.	
	G-001	Update date to revised Adv. for Bids date. I will provide this.	
	G-001	Add block after CCS block as follows: DEPT. OF ENTERPRISE SERVICES, E&S Contracting Agency Gloria Miller Gloria.Miller@des.wa.gov PO Box 9146 Spokane, WA 99209 (509) 389-5819	
	G-001	Add a heading for the address and parcel number information. Is this project site information?	
	A/E Review	Verify that all Owner review comments and the Plan Review comments from the City of Spokane have been addressed.	
	A/E Review	Verify documents are complete.	
	A/E Review	Verify documents have been coordinated between disciplines.	

SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 DESCRIPTION OR WORK

- A. Work of this Section includes everything necessary and incidental to design, provide, modify and install a sprinkler system within the building. The entire building shall be protected by a wet pipe automatic sprinkler and standpipe system as applicable.
- B. All work shall be installed in accordance with NFPA 13 and all Washington State and local Building Codes and as approved by the Fire Marshal.
- C. Sprinkler system shall be sized and spaced in accordance with the latest edition of NFPA 13.
- D. Work includes relocation of existing sprinkler heads to accommodate installation of new walls and ceilings for a limited area within the building. Extend existing piping down, or relocate existing piping up, as required to accommodate new ceilings. Re-use existing sprinkler heads and escutcheon plates unless they are damaged, corroded or non-functional. Install new heads and escutcheon plates where the existing heads or plates are damaged, corroded or non-functional. Relocate heads if necessary to accommodate other ceiling mounted devices, obstructions or equipment located in or above the new ceiling. If additional heads are required due to difference in wall configuration, occupancy, hazard, building geometry or obstructions, provide new heads and escutcheon plates to achieve a complete wet pipe sprinkler system in all areas of the remodel.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Escutcheons.
 - 3. Supports and anchorages.

1.4 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Escutcheons.
- B. Submit multiple copies of catalog data sheets for all materials. Submittals shall include the following: Detailed working drawings and hydraulic calculations shall be prepared and submitted for approval before fabrication of the project. Working drawings shall be submitted in complete sets (partial submission will not be acceptable) and shall bear the Contractor's license stamp, Identity of the system designer and computer program used in the calculation of hydraulic information. Sprinkler head type and location shall be in accordance with NFPA 13 and approved by the Owner's Representative and the Fire Marshal prior to installation.
- C. Fire Marshal approval of submittals is for permission to proceed and does not authorize design, products or installation not conforming to referenced codes and standards and this specification. Alternates require specific approval by the Fire Marshal.
- D. Upon completion of the work, the Contractor shall provide reproducible As-Built Drawings to the Owner. Final approvals are subject to receipt of acceptable As-Built Drawings.
- E. Fire protection system shop drawings shall be submitted to the architect or engineer of record for review. Contractor shall also forward them to the Fire Marshal. The drawings shall have a notation indicating the shop drawings have been reviewed and that they have been found to be in general conformance with the design of the building. The installation of the sprinkler system shall not commence until the shop drawings are approved by the Fire Marshal. Drawings shall be stamped by a C-16, C-34 or C-36 specialty contractor, a Class "A" General Contractor, or a fire protection engineer, civil engineer or mechanical engineer.
- F. Submittals having any content which is incomplete or unclear will be returned without review or approval.
- G. Discharge patterns and application data shall be included in submittals for sidewall, water curtain, and similar special purpose sprinklers.

- H. Operating Instructions: Provide instruction charts describing operation and proper maintenance of system equipment.

1.6 QUALITY ASSURANCE

- A. The entire sprinkler system shall be hydraulically calculated. All calculations and plans shall be submitted to the Washington State Fire Marshal for approval.
- B. Those parts of the piping system shown on the Drawings are minimum.
- C. Calculation shall be based on the following:
 - 1. Requirements of Regulatory Agencies: The system shall meet all the requirements of the governing codes.
 - 2. Reference Standards: NFPA 13, Sprinkler System Installation.
 - 3. International Fire Code
- D. Installer Qualifications
 - 1. Installer shall hold a valid Washington contractor's license.
 - 2. Installer shall demonstrate satisfactory installations of comparable systems within the preceding five years, including references.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

- A. The Contractor shall coordinate work specified in other Divisions to avoid any interference with the effectiveness of the fire protection system. Shop drawings shall include elevations of equipment and piping specified in other Divisions to assure coordination. The fire protection system shall be coordinated with work specified in other Divisions to assure that conflicts will not arise with structural, mechanical, electrical or architectural features of the building. Any changes required by field coordination, even after the approved shop drawings, shall be provided and installed at no cost to the Owner.
- B. The Contractor shall coordinate the fire sprinkler and alarm work to ensure full awareness of the location of all control valves, flow switches, tamper switches, and alarm and signal switches.
- C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- D. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, **1/8-inch** maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, **1/8 inch** thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

- B. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

- A. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS – COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.

- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Clean pipe and fittings and keep interiors clean throughout installation. Provide caps on ends of cleaned piping.
- M. Use full pipe lengths; random lengths joined by couplings will not be accepted.
- N. Provide for expansion and contraction of all pipe and for seismic movement.
- O. Provide reducing fittings for all changes in pipe size; provide fittings for all changes in pipe direction. Riser piping shall be installed plumb with offset fittings used where alignment adjustment is necessary.
- P. Provide unions for pipe sizes below two-inch and flanged or grooved fittings for sizes two-inch and above to permit disconnection of equipment.
- Q. Prepare all piping having welds for Fire Marshal inspection prior to installation.
- R. On-site fire code welding permits shall be obtained from the Fire Marshal, and shall be done by a currently certified welder.
- S. Piping arrangement shall avoid beams, columns, ducts, lighting fixtures, doors, windows and similar obstructions for openings.
- T. All piping shall be installed to permit thorough draining.
- U. Piping Accessories and Equipment Installation
- V. Installation of Fire Sprinkler Heads: In all tile ceiling areas, install sprinkler heads at the center of ceiling tiles align with light fixtures. All locations shall be as approved by the architect and engineer prior to installation.
- W. Installation of Threaded Pipe and Fittings
- X. Remove all fins and burrs; apply lubricant to male threads only.
- Y. Apply red oxide and oil paint or Teflon tape to all exposed threads.
- Z. Identification Signs: Install in accordance with referenced standards.
- AA. Sprinkler Head Guards: Install sprinkler head guards in storerooms and where subject to impact.
- BB. Escutcheons: Install on pipes passing through walls, partitions, floors and ceilings.
- CC. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping
 - a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - 2. Existing Piping: Use the following:
 - a. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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 unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

END OF SECTION 21 05 00

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SECTION 21 13 13

WET PIPE 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. Sprinklers.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Wet Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications
 - a. Office and Public Areas: Light Hazard.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design
 - a. Light-Hazard Occupancy: .15 at 1500 square feet area.

4. Maximum Protection Area per Sprinkler: Per UL listing.
 - a. Mechanical Equipment Rooms: 120 square feet.
 - b. Electrical Equipment Rooms: 120 square feet.
 - c. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Electrical drawings.
 2. HVAC drawings.
 3. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. All ceiling devices including but not limited to speakers, smoke detectors, strobes etc.
- E. Qualification Data: For qualified Installer and professional engineer.
- F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- G. Field Test Reports and Certificates: 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."
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 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.

- B. 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.
- C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify Architect and Construction Manager no fewer than seven days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without written permission.

1.9 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40 standard Weight, Black-Steel Pipe: ASTM A53. Pipe ends may be factory or field formed to match joining method.
- B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Uncoated, Steel Couplings: ASTM A 865, threaded.
- D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 175, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 175.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 175.
- H. Adjustable Drop Nipples

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 175.
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.

2.3 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AFAC Inc.
 2. Globe Fire Sprinkler Corporation
 3. Reliable Automatic Sprinkler Co., Inc.
 4. Tyco Fire & Building Products LP
 5. Central Fire Protection
 6. Victaulic Company
 7. Viking Corporation
- B. General Requirements: Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
- C. Sprinkler Heads: UL listed or Factory Mutual approved, 155°F - 165°F for all ordinary temperature classified areas. Special purpose sprinklers for unique hazard protection, such as high-piled stock, curtain wall, window protection, etc., shall be appropriately selected by the Contractor and shall be approved by the Fire Marshal.
- D. Ceiling Mounted: Pendant type recessed into the ceiling and concealed by a flat cover plate painted to match the ceiling color. Reliable Model "G1", Central or equal.
- E. Exposed Piping: Upright except where limited space requires pendant; natural brass finish. Reliable Model G, Central or equal.
- F. Extended coverage type may be used in accordance with their listing.
- G. Automatic Sprinklers with Heat-Responsive Element
 1. Early-Suppression, Fast-Response Applications: UL 1767.
 2. Nonresidential Applications: UL 199.
 3. Residential Applications: UL 1626.
 4. Characteristics: Nominal orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- H. Sprinkler Finishes

1. Chrome plated.
- I. 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.
- J. Sprinkler Guards: Hazardous Areas
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP
 - c. Victaulic Company
 - d. Viking Corporation
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.4 ESCUTCHEONS

- A. Refer to Section 21 05 00 – Common Work Results for Fire Suppression.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Obtain fire flow test results from owner, if available. If not available, 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.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements
 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 2. 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.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- 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 and smaller.
- E. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- F. Fill sprinkler system piping with water.

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 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having 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.

3.4 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels. Coordinate locations of all lighting fixtures, diffusers, smoke detectors and all ceiling devices.
- B. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.5 ESCUTCHEON INSTALLATION

- A. Refer to Section 21 05 00 – Common Work Results for Fire Suppression.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.8 PIPING SCHEDULE

- A. Schedule 10 pipe may be used in lieu of Schedule 40 pipe in sizes 2-1/2 inches and larger.
- B. Schedule 40 pipe shall be used on sprinkler system risers and piping serving fire department connections.
- C. Standard-pressure, wet-pipe sprinkler system up to 2 inch shall be one of the following:
 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
- D. Standard-pressure, wet-pipe sprinkler system, 2 1/2 inch and larger, shall be one of the following:
 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

3.9 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Concealed sprinklers.
 3. Wall Mounting: Sidewall sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 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.
 4. Residential Sprinklers: Dull chrome.
 5. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. Requirements under this section includes required work that is common to multiple sections in Division 23 and shall be complied with by all suppliers and subcontractors

1.3 DEFINITIONS

- A. A/E: Prime design consultant responsible for preparation of these specifications.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- G. The following are industry abbreviations for plastic materials:
 - 1. The following abbreviations are also referenced in Division 22.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- H. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Provide submittals per Division 01, Section 013300, "Submittal Procedures."

- B. Product Data: Submit product data for each type of product indicated herein. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Required in the following areas: Mechanical Rooms, Pump Rooms, shafts, and congested areas required for coordination. Include as a minimum all piping and ductwork.
 - 2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Wiring Diagrams: For power, signal, and control wiring.
 - D. Operation and Maintenance Data:
 - 1. All valves and specialty valves (Valve tag list),
 - 2. Piping system accessories including, but not limited to; strainers, expansion tanks, meters, gages, thermometers, traps, filters, etc.
 - 3. Ductwork system accessories including, but not limited to; fire and smoke dampers, backdraft dampers, terminal units, etc.
 - 4. All equipment that includes an electrical connection and/or has recommended maintenance, along with all related accessories.
 - 5. All controls.
- 1.5 QUALITY ASSURANCE
- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
 - B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
 - C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
 - D. 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.
 - E. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics (such as larger motor horsepower) may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- 1.6 PROJECT CONDITIONS
- A. Do not install products or materials that are wet, moisture damaged, or mold damaged.

- B. Field Measurements: Verify actual dimensions of site conditions by field measurements before fabrication.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 Transitions and offsets beyond the scope of work

- A. Check drawings of other trades to verify spaces in which work will be installed. Establish exact locations of piping and ducts in such a manner as to conform to structure, avoid obstructions, and keep openings and passageways clear. Lines that must pitch, or that must have a constant elevation, shall have the right-of-way over lines not so restricted. Maintain maximum headroom. If space conditions appear inadequate, notify the A/E before proceeding with the work. Make reasonable modifications in the work without extra cost as needed to prevent conflict with work of other trades and for proper execution of the work.
- B. If the total additional weight of sheet metal or piping materials (including associated fittings, hangers, seismic restraints and insulation) required for piping offsets which are not indicated or inferred on the contract documents exceeds nine percent (9%) of the total weight of the piping system, the amount exceeding this percentage may be considered to be beyond the requirements of these documents.
- C. In order for additional compensation to be considered for transitions and offsets in excess of the amount stated in Paragraph B above, the Contractor shall submit to the A/E a detailed take-off of all materials indicated on the contract documents. The Contractor shall also submit a separate take-off along with coordination drawings or marked-up contract drawings with yellow highlighting indicating specifically the transitions and offsets considered to be "extra work." Additional compensation will only be considered if take-offs and drawings are received by the A/E four weeks in advance of the fabrication of conflicting work in the area of concern so that the A/E may be able to determine ways to minimize or eliminate the extra work.

1.9 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.

PART 2 - PRODUCTS

2.1 STEEL PIPE HANGERS AND EQUIPMENT SUPPORTS

- A. Description: MSS SP-58-2009; "Pipe Hangers and support– Materials, Design, Manufacture, Selection, Application and Installation": Types 1 through 59, factory-fabricated components.

Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

1. Basis of Design: Anvil.
2. Manufacturers:
 - a. Anvil.
 - b. B-Line Systems, Inc.
 - c. ERICO/Michigan Hanger Co.
 - d. Hubbard Enterprises/HOLDRITE®
 - e. PHD Manufacturing, Inc.

B. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts. For piping 2" and below, manufactured specialty products formed from pre-galvanized commercial steel.

1. The total weight of piping and components upon each trapeze span shall not exceed the manufacturers load rating. Load ratings must include a minimum 2 X safety factor.
 - a. Hubbard Enterprises/HOLDRITE EZ-Strut™ or owner approved equivalent.

2.3 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

1. Basis of Design: Unistrut Corp.; Tyco International, Ltd.
2. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - c. Hubbard Enterprises/HOLDRITE®
 - d. PHD Manufacturing, Inc.
 - e. Unistrut Corp.; Tyco International, Ltd.

B. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

1. Basis of Design: Pipe Shields, Inc.
2. Manufacturers:
 - a. Carpenter & Paterson, Inc.
 - b. ERICO/Michigan Hanger Co.
 - c. Pipe Shields, Inc.

- B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Basis of Design: Hilti, Inc.
 - 2. Manufacturers:
 - a. Hilti, Inc.
 - b. Hubbard Enterprises/HOLDRITE®
 - c. ITW Ramset/Red Head.
 - d. Powers Fasteners.

2.6 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
 - 1. Basis of Design: MIRO Industries
 - 2. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
- B. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. MIRO Industries.
- C. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Basis of Design: MIRO Industries
 - 2. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - 3. Base: Stainless steel.
 - 4. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.

5. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- D. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
1. Manufacturers:
 - a. Portable Pipe Hangers.
 2. Bases: One or more plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- E. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
1. Basis of Design: HOLDRITE Corp.; Hubbard Enterprises.
 2. Manufacturers:
 - a. C & S Mfg. Corp.
 - b. HOLDRITE Corp.; Hubbard Enterprises.
 - c. Samco Stamping, Inc.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Plenum Rated Pipe Clamps: ASTM E-84 25/50 plastic clamps from Hubbard Enterprises/HOLDRITE.
- C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi , 28-day compressive strength.

2.10 EXPANSION COMPENSATORS

- A. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Metraflex Metraloop
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Flex-Pression, Ltd.
2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with **solder** joint end connections.
 - a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
3. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged end connections for NPS 2-1/2 and larger.
 - a. NPS 2 and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
 - b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
 - c. NPS 8 to NPS 12: Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.

2.11 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Metraflex, Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Flex-Weld, Inc.
 - e. Hyspan Precision Products, Inc.

2.12 MATERIALS FOR ANCHORS

- A. Indicate alignment-guide length and maximum spider travel on Drawings.
- B. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
- C. Steel Shapes and Plates: ASTM A 36/A 36M.
- D. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- E. Washers: ASTM F 844, steel, plain, flat washers.
- F. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Stud: Threaded, zinc-coated carbon steel.
2. Expansion Plug: Zinc-coated steel.
3. Washer and Nut: Zinc-coated steel.

G. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
3. Washer and Nut: Zinc-coated steel.

B. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.

C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi , 28-day compressive strength.

2.13 THERMOMETERS

A. Manufacturer:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram/Marshalltown.
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Miljoco.

B. Thermometers: Adjustable angle, Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.200.

1. Case: Highly polished, hermetically sealed, stainless steel with 5-inch diameter.
2. Element: Bimetal coil.
3. Dial: Satin-faced, or highly polished, non-reflective aluminum with permanently etched scale markings.
4. Window: Double strength Glass.
5. Connector: Adjustable angle, 1/2" with ASME B1.1 screw threads.
6. Stem: stainless steel, for thermo-well installation and of length to suit installation.
7. Accuracy: Plus or minus one percent of range or plus or minus one scale to maximum of 1.5 percent of range. Scale shall be degrees Fahrenheit, unless otherwise indicated, suitable for the media operating temperatures.
8. Thermometers shall conform generally to the following:

SERVICE	RANGE – DEGREES F.	DEG. F/DIV.
Heating Hot Water	30-240	2
Condenser Water	30-130	1
Chilled Water	0-100	1
Steam and Condensate	50 to 400	2
Air Ducts	40 to 120	1

C. Thermowells: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer with extension necks of suitable length for insulated piping. Furnished by same manufacturer as thermometers.

1. Threaded Stainless Steel
2. Pressure Rating – not less than piping system design pressure.
3. Stem Length – Extend 2” into fluid or to extend to center of pipe
4. Extension for insulated piping –2” nominal but not less than thickness of insulation
5. Threaded cap nut – With chain permanently fastened to well and cap.

2.14 PRESSURE GAUGES

A. Manufacturers:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram/Marshalltown
3. Trerice, H. O. Co.
4. Weiss Instruments, Inc.
5. Miljoco

B. Direct-Mounting, Dial-Type Pressure Gages:

1. Indicating-dial type complying with ASME B40.100.
2. Case: Liquid-filled type, 4-1/2-inch diameter Grade A phosphor Bronze.
3. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
4. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
7. Ring: Stainless steel.
8. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
9. Range for Fluids under Pressure: Two times operating pressure.
10. Scale: Scale shall be psig.

C. Shutoff Cocks for Gauges: 1/4" NPT lever handle ball valve with solid chrome-plated brass ball. Same manufacturer as gauge.

D. Pressure Snubbers: Filter type snubbing element, brass housing. Same manufacturer as gauge.

2.15 TEST PLUGS

A. Manufacturers

1. Peterson Equipment Co., Inc.
2. Sisco Manufacturing Co.
3. Or equal.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem beyond insulation for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 degree F.

D. Core Inserts: One or two self-sealing neoprene, valves gasketed orifice, suitable for inserting a 1/8" OD probe assembly.

1. Insert material for air, water, oil, or gas service at 20 to 200 degree F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 degree F shall be EPDM.

2.16 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.
 4. Basis of Design: Pipeline Seal and Insulator, Inc. "Thunderline Link Seal."
 5. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

2.17 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing. Underdeck Clamp: Clamping ring with set screws.
- E. PVC Pipe: ASTM D 1785, Schedule 40.

2.18 ESCUTCHEONS

- A. General: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type (walls and ceilings): Deep-drawn, box-shaped brass with chrome-plated finish.
- C. One-Piece, Stamped-Steel Type (walls and ceilings): With set screw or spring clips and chrome-plated finish.
- D. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.19 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Refer to Division 01, Section 017329, "Cutting and Patching" and Division 02, Section 024119, "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated or, if conflicts exist, as indicated on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.

- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated and/or code-required slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors where exposed to view from any location in a finished space and in stairways, according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Other Piping: One-piece, stamped-steel type with spring clips.
 - 2. Existing Piping: Same as for new piping.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other potentially-wet areas two inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. **Steel** Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to two inches above finished floor level. Refer to Division 07, Section 076200, "Sheet Metal Flashing and Trim" for flashing.
 - 3. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 for materials and installation.
- N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for one inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07.

- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve (unless valve construction facilitates disassembly) and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals in piping systems.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 HANGER AND SUPPORT APPLICATIONS

- A. Comply with MSS SP-69 and 89 for pipe hanger selections and applications that are not specified otherwise in piping system Sections.
- B. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use padded hangers for piping that is subject to scratching.
- E. 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 degrees F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. U-Bolts (MSS Type 24): For support of heavy pipes.

6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 and above, with steel pipe base stanchion support and cast-iron floor flange.
 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers if longer ends are required for riser clamps.
- G. 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. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- H. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- I. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

- L. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- M. Trapeze Pipe Hanger Installation: 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 above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- N. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- O. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- P. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- Q. Select and locate 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.
- R. Install lateral bracing with pipe hangers and supports to prevent swaying.
- S. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 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.
- T. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- U. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- V. Insulated Piping: Comply with the following:
 - 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 according to ASME B31.1 for power piping and 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.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 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 14: 24 inches long and 0.075 inch thick.
 - 5. Insert Material: Length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- 3.6 PAINTING
- A. Painting of HVAC systems, equipment, and components is specified in Division 09, Sections 099123, "Interior Painting" and 099113, "Exterior Painting."
 - B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- 3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES
- A. Refer to Division 05.
 - B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
 - C. Field Welding: Comply with AWS D1.1.
- 3.8 GROUTING
- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- 3.9 COMMISSIONING
- A. Notify the Commissioning Agent one week prior to start up of equipment.
 - B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
 - C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 05 00

SECTION 23 05 40

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 EXTENT OF VIBRATION CONTROL WORK

- A. Vibration Isolation: All equipment and piping as noted on the equipment, ductwork and piping schedules in Part 3 of the specification shall be provided with vibration isolators to prevent the transmission of vibration and transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
- B. Pipe Riser Resilient Supports: Provide resilient support for all risers subject to significant expansion and/or contraction.

1.3 EXTENT OF SEISMIC CONTROL WORK

- A. Seismic Restraints for New Construction: Provide professional structural engineering for seismic control of all new and relocated equipment, ductwork and piping specified in Division 23. Provide all necessary seismic restraints to meet the requirements of the Code and referenced Standards.
- B. Seismic Restraints for Remodeled Areas: Provide professional structural engineering for seismic control of all existing equipment, ductwork and piping that is normally provided under Division 23 and that will remain in place in areas where new ceilings are being provided as part of this project. Provide all necessary seismic restraints to meet the requirements of the Code and referenced Standards.
- C. Existing Construction: Provide professional structural engineering for seismic control of the existing equipment, ductwork and piping listed below that is not located within the remodeled areas. Provide all necessary seismic restraints to meet the requirements of the Code and referenced Standards
- D. Omission of restraints for small components: Restraints may be omitted for smaller equipment, ductwork and piping only where specifically allowed by Code and referenced Standards, and where specifically allowed by the Qualified Professional Engineer (QPE) specified below. Restraints may only be omitted after the QPE has determined that adequate flexibility will be provided between restrained and non-restrained connected elements and determined that movement of unrestrained elements will not cause damage to adjacent elements.

1.4 DEFINITIONS

- A. Code: 2006 International Building Code (IBC).
- B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.5 SEISMIC CONTROLS ENGINEERING REQUIREMENTS

- A. Qualified Professional Engineer: Contractor shall provide the services of a qualified professional structural engineer to engineer, design and/or select anchorage methods for all equipment, ductwork and piping specified in this Division of the Specifications. This requirement applies to equipment, ductwork and piping that is supported from above or below and that is supported with vibration isolation or not.
 - 1. A qualified professional engineer (QPE) familiar with all of the applicable codes and design standards related to seismic protection of HVAC ductwork, piping and equipment and qualified in structural design of seismic protections and their interaction with building structures shall be responsible for execution of the work herein. Where applicable, the QPE shall also analyze wind forces and shall utilize these forces (if greater than seismic forces) when designing component anchorages. The tasks of the QPE are as follows:
 - a. Shall be responsible for the preparation of drawings, analysis, specifications, and inspection of the seismic protections required by Code and referenced Standards.
 - b. Shall coordinate with the Structural Engineer of Record of the building structure for the proper establishment of seismic values, applicable codes, and other requirements of the project related to seismic and wind design.
 - c. Shall verify the applicability of all codes and design standards with the Authority Having Jurisdiction and shall coordinate with the Authority where codes conflict or are open for interpretation for variances and clarifications.
 - d. Shall inform the Contractor where special provisions in other work, such as routine hanger hardware selection, are required to accommodate seismic restraint. Changes from specified hanger hardware will require A/E prior approval and shall be provided without change in Contract cost.
 - e. Shall analyze specified and/or Contractor-proposed ductwork and piping materials along with associated joining methods for seismic-related strength (flexibility and/or "toughness") and determine bracing spacing that will maintain appropriate integrity of the ductwork and piping during and after a design seismic event. If changes in construction are recommended in order to minimize the frequency of bracing, these shall be submitted for A/E review and will only be considered if a significant cost credit is offered.
 - f. Shall analyze specified and/or Contractor-proposed ductwork and piping materials along with associated joining methods for flexibility and determine the appropriate point bracing should stop along a specific run (when importance factor changes or when size reduces to a point where bracing may not be required).
 - g. Shall acquire equipment certifications for seismic worthiness from all equipment manufacturers where required by applicable codes or these specifications. These certifications shall be included in a final report to the Owner.
 - h. Shall perform calculations and select all required anchors and restraints.
 - i. Shall develop drawings (bearing QPE seal) of seismic controls that document the seismic anchors and restraints, their layout and the details for their installation. Where design standards apply, the drawings shall note the locations and identify the standard details that apply.
 - 2. The QPE shall be licensed to provide structural engineering in the project state.

- B. Seismic-Restraint Loading: Engineering, selection and placement of seismic restraints shall be determined by the QPE after reviewing the project with the Structural Engineer of Record (for the building structure). Obtain all needed parameters directly from that engineer and clearly document these parameters within the submittals. For the purpose of pricing only, use the following values:
1. Site Class as Defined in the IBC: D.
 2. Seismic Design Category: C
 3. Risk Category: II
 4. S_{DS} : 0.342 G
 5. S_{D1} : 0.179 G
- C. Components with Importance Factor $I_p=1.5$: Engineering, selection and placement of seismic restraints shall be determined by the QPE based on the following components having the an Importance Factor of $I_p=1.5$:
1. Fuel source equipment and all sizes of piping.
 2. Steam and condensate equipment and piping of all sizes.
 3. All sizes of piping located in Electrical Rooms, Mechanical Rooms, Generator Rooms and Refrigeration Rooms. This applies to all kinds of piping, whether connected to equipment in those rooms or not.
 4. Heating water equipment and piping greater than 2" size. Piping 2" in size and less that does not have a readily-accessible isolation valve separating it from any piping greater than 2" size.
 5. Chilled water equipment and piping greater than 2" size. Piping 2" in size and less that does not have a readily-accessible isolation valve separating it from any piping greater than 2" size.
 6. All supply air equipment and ductwork upstream of terminal units.
 7. Supply terminal units.
 8. Supply ductwork downstream of terminal units greater than 3 square feet in area.
 9. Isolation room exhaust equipment and ductwork of all sizes.
 10. Return and exhaust equipment and ductwork greater than 3 square feet in area.
 11. All other components required by Code to have an importance factor of $I_p=1.5$.
- D. Components with Importance Factor $I_p=1.0$: All components not identified above as having an Importance Factor of $I_p=1.5$.

1.6 RELATED WORK

- A. Seismic Anchorage for Housekeeping Pads:
1. Housekeeping pad reinforcement and monolithic pad attachment to the structure details and design shall be provided as part of this work, if not already adequate as indicated in the documents of other Divisions. This requirement applies only to pads that receive seismic forces for equipment anchored under this Section.
 2. Housekeeping pads shall be coordinated by the seismic controls engineer to result in sizing such that a minimum edge distance of ten (10) bolt diameters is provided all around the outermost anchor bolts to allow development of full drill-in wedge anchor ratings. If cast-in anchors are to be used, the housekeeping pads shall be sized to accommodate the ACI requirements for bolt coverage and embedment.
 3. Provide restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps, etc., in accordance with the requirements of the manufacturer's calculations.

1.7 VIBRATION ISOLATION AND RISER SUPPORT SUBMITTALS

- A. Product Data: For the following:
 - 1. Vibration Isolators: Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Construction Details and Calculations:
 - 1. 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 that riser system has been examined for excessive stress and that none will exist.
 - 2. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
- C. Operation and Maintenance Data.

1.8 SEISMIC CONTROL SUBMITTALS

- A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - 1. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - 2. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Construction Details and Calculations: For seismic-restraint details 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - 2. Seismic-Restraint Details:
 - 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 the 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. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Layout Drawings: Show coordination of seismic bracing for ductwork, piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints. Plans shall utilize copies of the contractor's coordination plans and shall show all locations and types for the following. The registered professional engineer must stamp plans.

1. All seismic brace locations.
2. All anchorage connections to the structure. Quantity and size
3. Brace reactions at all connection points to the structure, for Structural Engineer of Record use in checking suitability of the building structure.
4. Total vertical load at seismic brace locations.
5. Type and size of brace member.
6. Suspended utility max lbs per lineal foot or max pipe size at all seismic locations.
7. Minimum rod size at all seismic locations.
8. Vertical support anchors at non-seismic and seismic locations.
9. Horizontal members of all trapeze assemblies.

D. Operation and Maintenance Data.

1.9 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC and all local amendments unless requirements in this Section are more stringent.
- B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 FLEXIBLE PIPE CONNECTIONS

- A. General: Flexible pipe connectors shall be provided at all piping connections to rotating equipment, isolated equipment and elsewhere as indicated.
 1. Basis of Design: Mason Industries, Inc.,
 2. Manufacturers:
 - a. Mason Industries, Inc.
 - b. Metraflex
 - c. Twin City Hose
 - d. Unisource Manufacturing
- B. Flexible Spherical Expansion Joints: Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners, and Dacron tire cord frictioning. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ring between spheres to maintain shape and complete with split ductile iron and steel flanges with hooked or similar interlocks. Sizes 16" to 24" may be single sphere. Sizes ¾" to 1½" may have threaded bolted flange assemblies, one sphere and cable retention. ¼" and smaller connectors shall be rated at 250 psi up to 190°F with a uniform drop in allowable pressure to 190 psi at 250°F. 16" and larger connectors are rated 180 psi at 190°F and 135 psi at 250°F. Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5-minute factory test at twice the rated pressure. Concentric reducers to the above

specifications may be substituted for equal ended expansion joints. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods, as control rods are not desirable in seismic work. If control rods are used, they must have 1/2" thick Neoprene washer bushings large enough in area to take the thrust at 1,000 psi maximum on the washer area. Expansion joints shall be installed on the equipment side of the shut off valves. Submittals shall include two test reports by independent consultants showing minimum reductions of 20dB in vibration accelerations and 10dB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the shut off valves. Manufacturer shall verify materials are compatible with glycol or other chemicals to be utilized in the piping system.

1. Manufacturer: Mason Industries, Inc., Type "SAFEFLEX SFDEJ, SFEJ, SFDCR, or SFU" with Type "CR" control rods.

- C. Flexible Stainless Steel Hose: Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

Flanged		Male Nipples	
3 x 14	10 x 26	1/2 x9	1 1/2 x 13
4 x 15	12 x 28	3/4 x10	2 x 14
5 x 19	14 x 30	1x11	2 1/2 x18
6 x 20	16 x 32	1 1/4 x 12	
8 x 22			

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

1. Manufacturer: Mason Industries, Inc., Type "BSS."
2. Metraflex
3. Unisource Manufacturing

2.2 VIBRATION ISOLATORS

- A. General: Provide complete, engineered vibration-isolation systems. Engineering support shall be provided by a representative of the manufacturer, and shall be in full compliance with the manufacturer's recommendations and the following requirements.

1. Basis of Design: Mason Industries, Inc., utilizing the products specified in the following paragraphs.
2. Manufacturers:
 - a. California Dynamics Corporation.
 - b. Kinetics Noise Control.
 - c. Mason Industries, Inc.
 - d. Vibro-Acoustics.

- B. General Requirements:

1. Isolator Identification: All vibration isolators shall be clearly marked to show undeflected heights so that after installation and adjustment, deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being attained.

2. Provide a balanced set of isolators for each piece of equipment. Select isolators in accordance with equipment weight distribution to allow for no less than static deflection specified. All isolators for a single piece of equipment shall have approximately equal spring deflection. A minimum of four isolators per unit is required unless otherwise indicated.
3. Each isolator shall be numbered and color-coded to show location. Code number and color shall be marked on plans, on each equipment isolator, and on each base to ensure proper placement.
4. Operating Limits: All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.
5. The spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load.
6. The theoretical vertical natural frequency for each support point, based upon the load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than $\pm 10\%$.
7. Neoprene Mountings: All neoprene mountings shall have a shore hardness of 40–65 after minimum aging of 20 days, or corresponding oven-aging.
8. Neoprene Isolator Formulation: Formulation of the neoprene shall conform to AASHTO specifications for neoprene or ASTM D4014 specification for elastomer:
9. All vibration isolation hardware shall be designed or treated for corrosion resistance. Isolators exposed to the weather shall have steel parts zinc electroplated, PVC coated, plus a coating of neoprene or bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts, and washers shall be zinc electroplated.

C. Isolator Type 1: Two layers of $\frac{3}{4}$ " thick neoprene pad consisting of 2" square waffle modules separated horizontally by a 16-gauge galvanized shim. Load distribution plates shall be used as required. Basis of Design: Mason Industries, Inc., Type Super "W."

D. Isolator Type 2: Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "OPA" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Basis of Design: Mason Industries, Inc., Type Super "BR."

E. Isolator Type 3: Spring isolators shall be freestanding and laterally stable without any housing and complete with a molded neoprene cup or $\frac{1}{4}$ " neoprene acoustical friction pad between the baseplate and the support. Basis of Design: Mason Industries, Inc. Type "SLF."

F. Isolator Type 4: Restrained spring mountings shall have an SLF mounting as described in Type 3, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of $\frac{1}{2}$ " shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position, there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage Preapproval "OPA" Number from OSHPD in the State of California certifying the maximum certified horizontal and vertical load ratings. Basis of Design: Mason Industries, Inc., Type "SLR."

G. Isolator Type 5: Spring mountings built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of ¼" travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage Preapproval "OPA" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Basis of Design: Mason Industries, Inc., Type "SSLFH."

H. Isolator Type 6: Hangers shall consist of rigid steel frames containing minimum 1¼" thick neoprene elements at the top and a steel spring seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Basis of Design: Mason Industries, Inc., Type "30N."

I. Isolator Type 7: Hangers to be pre-compressed and locked at the rated deflection by means of a resilient seismic up-stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Basis of Design: Mason Industries, Inc., Type "PC30N."

2.3 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Provide complete, engineered equipment bases. Engineering support shall be provided by a representative of the manufacturer, and shall be in full compliance with the manufacturer's recommendations and the following requirements.
1. Basis of Design: Factory-fabricated products by Mason Industries, Inc.
 2. Manufacturers:
 - a. California Dynamics Corporation.
 - b. Kinetics Noise Control.
 - c. Mason Industries, Inc.
 - d. Vibro-Acoustics.
- B. Type B-1 Base: Steel Base, factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-1/2-inches clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Cross members shall be provided where necessary to support the equipment or to prevent twisting of the main members. The section depth of any frame member shall be not less than 1/10th of the length of the longest frame member and not less than 1/10th of the greatest span between support points. All frame members shall have the same depth.
 4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Type B-2 Base: A welded structural steel base constructed of angle iron or channels, designed to spread base area of equipment to increase stability and permit suspension with hanger rods.
- D. Type B-3 Base: Inertia Base, factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
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.

2. Base shall consist of a perimeter welded structural steel pouring form, 1/2" diameter reinforcing bars welded in place on 6" centers each way, pre-located equipment anchor bolts and pipe sleeves, and isolator brackets to reduce the mounting height of the equipment. The bottom edge of the steel reinforcing bars shall be 1-1/2" from bottom of the base. Drilled steel members shall have sleeves below the holes to receive anchor bolts. Thickness of the base shall be a minimum depth of 1/12th of the longest span, but not less than 6" deep. The base shall be sized a minimum overlap of 4" around the base of the equipment, and in the case of belt-driven equipment, 4" beyond the end of the drive shaft.
3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
4. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 VERTICAL RISER SUPPORTS

- A. General: Provide complete engineered pipe riser support systems. Engineering support shall be provided by a representative of the manufacturer, and shall be in full compliance with the manufacturer's recommendations and the following requirements. Submittal must be stamped and signed by a licensed professional engineer in the employ of the manufacturer.
 1. Basis of Design: Mason Industries, Inc., utilizing the following products:
 - a. Support spring mountings; SLF
 - b. Anchors; ADA.
 - c. Telescoping guides; VSG
 2. Manufacturers:
 - a. California Dynamics Corporation.
 - b. Kinetics Noise Control.
 - c. Mason Industries, Inc.
- B. Riser Supports: All vertical risers for systems with an operating temperature greater than 105 degrees F. and a height greater than 60 feet, or an operating temperature greater than 200 degrees F. and a height greater than 40 feet, shall be supported by spring isolators designed to support the riser filled with water. Riser that do not fall in these categories may utilize other means of support that will not result in more than 50% variation of force on any point of support under any operating condition.
 1. Riser anchors close to the center of the run shall direct movement up and down. The anchors shall be capable of holding an upward force equal to the water weight when the system is drained. Obtain the maximum allowed point loading from the building structural engineer of record. If one level cannot accommodate the anticipated force, anchors can be located on two or three adjacent floors.
 2. Steam Risers: If the riser is a steam riser, the design weight should not include water, except the isolators shall not be damaged if the pipe is filled with water. Assigned loads must be within the building design limits at the support points.
 3. Long Risers: Provide support spring mountings at levels above and below the anchor level(s) when loading at the anchor level(s) would otherwise exceed the recommendations of the anchor manufacturer, maximum floor loading or would result in an unreasonable stress in the piping system itself.

4. The initial spring deflection shall be a minimum of 0.75"(20mm) or four times the thermal movement at the isolator location, whichever is greater. Calculations shall include pipe stress at end conditions and branch off locations and the manufacturer must include installation instructions.
- C. Riser Guides: Provide telescoping guides where needed to maintain riser alignment. Resilient guides shall be spaced and sized properly depending on the pipe diameter. Submittals must include the initial load, initial deflection, change in deflection, final load and change in load at all spring and anchor support locations, as well as guide spacing. Proper provision shall be made for seismic protection as directed by the Seismic QPE.
- D. Coordination at top and bottom of risers: Riser support manufacturer's engineer shall direct the Contractor on special provisions needed for support and routing of horizontal piping that is connected to the top, bottom and at various midpoints of each riser. Provide additional spring hangers and similar provisions for horizontal piping as required to avoid unreasonable stress on piping and supporting elements.

2.5 SEISMIC-RESTRAINT COMPONENTS

- A. Manufacturers:
 1. Basis of Design: Pre-approved products where available from Mason Industries, Inc., custom designed products where not available from Mason Industries, Inc.
 2. Manufacturers:
 - a. International Seismic Application Technology (ISAT).
 - b. Kinetics Noise Control.
 - c. Mason Industries, Inc.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or OSHPD.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
 2. Even though the project may not be located in the State of California, all isolators that provide seismic restraint shall have an Anchorage Preapproval "OPA" Number from OSHPD (of the State of California) verifying the maximum certified load ratings.
 3. Seismic Cable Restraints consisting of galvanized steel aircraft cables shall be provided for vibration-isolated components.
 4. Seismic Solid Braces consisting of steel angles or channels shall be provided for all suspended components that are not vibration-isolated.
 5. Pipe clevis cross bolt braces are required in all restraint locations
 6. Provide hanger rod reinforcing to prevent buckling due to upward forces caused by restraints.
- C. Base-mounted equipment with vibration isolation: Where integral seismic restraints furnished with vibration isolators are not adequate, provide all-directional seismic snubbers consisting of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene.
- D. Restraint Anchors: Provide appropriate anchors to attach equipment, seismic restraints, and vibration isolation devices (if being used for seismic restraint), to the building structure. The

method of connection to the structure shall be identified at each location on the Layout Drawings. All components shall meet the requirements of the authorities having jurisdiction. Where available, anchors (such as wedge anchors) shall have an evaluation report number from the ICBO Evaluation Service, Inc. verifying its allowable loads

2.6 FACTORY FINISHES

- A. All vibration isolation and seismic restraint hardware shall be designed or treated for corrosion resistance.
- B. Items exposed to the weather shall have steel parts zinc electroplated, PVC coated, plus a coating of neoprene or bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial enamel.
- C. Nuts, bolts, and washers shall be zinc electroplated.
- D. Structural steel bases shall be thoroughly cleaned of welding slag, primed with zinc chromate and finished with two coats of industrial enamel.
- E. Field painting shall comply with requirements in Division 09. Verify compatibility of factory finishes with field-applied coats.

PART 3 - EXECUTION

3.1 VIBRATION ISOLATION INSTALLATION REQUIREMENTS

- A. Vibration Isolation for Piping:
 - 1. When piping connects to equipment is provided with vibration isolation and a flexible connection is not provided at the equipment, the first four pipe hangers shall be Type 7 with the same deflection as specified for the mountings under the connected equipment.
 - 2. Floor supported piping shall be isolated with Type 4 isolators.
 - 3. Do not support vibration isolated piping along with non-isolated piping on a common trapeze.
 - 4. Steel spring hanger boxes shall be rigidly mounted to the supporting structure-not located in the middle of the hanger rod.
 - 5. Hanger rods shall be aligned to clear the hanger box.
 - 6. Load-transfer isolators, when utilized, shall temporarily maintain the piping in a rigid position until installation is complete and fully loaded.
 - 7. Pipe anchors are not permitted in vibration isolated piping circuits.
- B. General Requirements for Equipment Bases:
 - 1. All bases shall be installed on housekeeping pads. All bases shall be sized to include equipment and motor without overhang.
 - 2. Motor-driven equipment shall be mounted with motors on a common base of sufficient rigidity to maintain permanent alignment.
 - 3. All bases shall have clearance of 1-1/2" between top of floor and underside of base.
 - 4. Inertia bases shall have 1-1/2" clearance for first 50 sq. ft. of area.

3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION REQUIREMENTS

- A. Install seismic restraints for all equipment and all sizes of ductwork and piping except where omission of restraints for smaller sizes is specifically allowed by Code and specifically allowed by the QPE and seismic restraint manufacture's guidelines.
- B. Install cables so they do not bend across edges of adjacent equipment or building structure.
- C. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- D. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- E. 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.
- F. 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.
- G. Drilled-in Anchors:
 - 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 the 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 Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: 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.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. The seismic QPE shall review all piping and ductwork that crosses building seismic joints and shall select or design appropriate restraints on both sides. Consider the anticipated displacement of the building structure at the joints and the flexibility of the specified duct and piping components when determining placement of restraints. If displacement will result in excessive forces within the ductwork or piping itself, which cannot be mitigated by restraint placement, contact the A/E for direction.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping 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.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

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SECTION 23 05 50

IDENTIFICATION FOR PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUBMITTALS

- A. Product Data: Submit for each type of product indicated.
- B. Valve numbering scheme.
- C. Valve Schedules: For each piping system to include in maintenance manuals.

1.3 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 degree F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances 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.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: As appropriate for pipe size.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to existing valves on system.

3.5 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

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SECTION 23 05 90

TESTING ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. Division 23, Section 230500 is directly related. Other sections are indirectly related and shall be reviewed.

1.2 SUMMARY

- A. Work under this section shall include furnishing all labor, materials, tools, and equipment necessary for testing, adjusting, and balancing (TAB) necessary to place all systems and items of equipment, specified in Division 23, in proper operating condition. All work shall be completely tested as required by this section and applicable city, county, and state codes and ordinances.
- B. Submit copies of all testing, adjusting, and balancing data to A/E.
- C. Leak and pressure testing of piping and duct systems and rotational testing of motors shall be performed by the installing contractor.
- D. TAB shall include the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - b. Dual-duct systems.
 - c. Variable-air-volume systems.
 - d. Multizone systems.
 - 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - b. Variable-flow systems.
 - c. Primary-secondary systems.
 - 3. Steam systems.
 - 4. HVAC equipment quantitative-performance settings.
 - 5. Kitchen hood airflow balancing.
 - 6. Laboratory fume hood airflow balancing.
 - 7. Exhaust hood airflow balancing.
 - 8. Space pressurization testing and adjusting.
 - 9. Stair-tower pressurization testing and adjusting.
 - 10. Smoke-control systems testing and adjusting.
 - 11. Existing systems TAB.
 - 12. Verifying that automatic control devices are functioning properly.
 - 13. Domestic water recirculation systems.
 - 14. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Air Systems: Includes all outside air, supply air, return air, transfer air, exhaust air, relief air and make-up air systems.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- F. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.
- G. Hydronic Systems: Includes chilled water, condenser water, heating hot water, and glycol-water systems, and heat recovery water systems.
- H. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- I. RC: Room criteria.
- J. Report Forms: Test data sheets for recording test data in logical order.
- K. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
- L. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
- M. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.
- N. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- O. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- P. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- Q. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- R. TAB: Testing, adjusting, and balancing.

- S. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- T. Terminal Unit: A device that controls the temperature and/or volume of air that enters or leaves a zone.
- U. Test: A procedure to determine quantitative performance of systems or equipment.
- V. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.
- W. Zone: The space that is controlled by a terminal unit or other temperature controlling device.

1.4 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit two copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- C. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Contracting: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
- B. TAB Firm Qualifications:
 - 1. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the A/E and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
 - 2. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the A/E and submit another TAB Specialist for approval.
 - 3. TAB Specialist Responsibilities:
 - a. The General Contractor, within 60 days after the notice to proceed, shall identify TAB specialist who would be responsible for supervising, coordinating, scheduling and reporting all TAB work and related activities and provide necessary information as required by the A/E.
 - b. All TAB work shall be performed under the direct supervision of the TAB specialist.

- c. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB. The reports shall be signed by the TAB specialist and shall bear the seal of the TAB standard.
 - d. The TAB Specialist would follow all TAB work through its satisfactory completion.
 - e. Final markings of settings of all HVAC adjustment devices.
 - f. Permanently mark location of duct test ports.
4. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of three projects comparable in size and complexity of this project and must be certified so by the TAB agency in writing.
- C. Test Equipment Criteria: The basic instrumentation requirements and accuracy/calibration required by AABC, National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.
1. Instrumentation Calibration: Calibrate instruments at least every year or more frequently if required by instrument manufacturer.
 2. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- D. Tab Criteria and Tolerances:
1. One or more of the applicable AABC or NEBB publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.
 2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36 as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.
 - a. Air handling unit and all other fans, cubic feet per minute: Minus 5 percent to plus 10 percent.
 - b. Air terminal units (maximum values): Minus 5 percent to plus 10 percent.
 - c. Exhaust hoods/cabinets: Minus 5 percent to plus 10 percent.
 - d. Minimum outside air: 0 percent to plus 10 percent.
 - e. Individual rooms: air outlets and inlets, and air flow rates not mentioned above: Minus 10 percent to plus 10 percent.
 - f. Individual rooms where both supply and return/exhaust air volume is indicated: Unless the A/E confirms that room pressurization is not a requirement, the difference between the total supply to a room and the total exhaust/return from that same room shall be 0 percent to plus 10 percent. The required difference is determined by subtracting one total (sum of values indicated at terminals in the room) from the other.
 - g. Heating hot water pumps: Minus 5 percent to plus five percent.
 - h. Chilled water and condenser water pumps and coils: Minus 5 percent to plus 10 percent.
 3. Systems shall be adjusted for energy efficient operation as described in PART 3.
 4. Typical TAB procedures and results shall be demonstrated to the A/E for one air distribution system (including all fans, three terminal units, three rooms) and one hydronic system (pumps and three coils) as follows:
 - a. When field TAB work begins.
 - b. During each partial final inspection and the final inspection for the project if requested by Owner.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, "Section II, " Required Instrumentation for NEBB Certification."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

1.9 APPLICABLE PUBLICATIONS

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text, the publications are referenced to by the initials of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE): 2003 HVAC Applications ASHRAE Handbook, Chapter 37, Testing, Adjusting, and Balancing and Chapter 47
- C. Associated Air Balance Council (AABC): 2002 6th Edition AABC National Standards for Total System Balance
- D. National Environmental Balancing Bureau (NEBB):
 - 1. 2015 8th Edition Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): 2002 3rd Edition HVAC SYSTEMS-Testing, Adjusting and Balancing.

PART 2 - PRODUCTS

2.1 PLUGS

- A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

- A. See Division 23, Section 23070, "Mechanical Insulation". Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 01,017839, Section "Project Record Documents."

- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems-Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible, and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine system pumps to ensure absence of entrained air in the suction piping. Verify that start-up strainers have been removed from the pump suction diffusers.
- N. Examine equipment for installation and for properly operating safety interlocks and controls.
- O. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Spot-check thermostats to determine if they have been calibrated by the Control Contractor.

7. Sensors are located to sense only the intended conditions.
 8. Sequence of operation for control modes is according to the Contract Documents.
 9. Controller set points are set at indicated values.
 10. Interlocked systems are operating.
 11. Changeover from heating to cooling mode occurs according to indicated values.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balance, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and equipment vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.
- B. Coordinate TAB procedures with any phased construction completion requirements for the project. Provide TAB reports for each phase of the project prior to partial final inspections of each phase of the project.
- C. Allow sufficient time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.
- D. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- E. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

- F. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- G. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.6 PROCEDURES FOR DUAL-DUCT SYSTEMS
- A. Verify that the cooling coil is capable of full-system airflow, and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate mixing-box controls and to overcome resistance in the ducts and outlets downstream from mixing box. If insufficient static pressure exists, increase the airflow at the fan.
- C. Test and adjust the constant-volume mixing boxes as follows:
1. Verify both hot and cold operations by adjusting the thermostat and observing the air temperature and volume changes.
 2. Verify sufficient inlet static pressure before making volume adjustments.

3. Adjust mixing box to indicated airflows within specified tolerances. Measure the airflow by Pitot-tube traverse readings, totaling the airflow of the outlets; or by measuring static pressure at mixing-box taps if provided by box manufacturer.
- D. Remeasure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate mixing-box controls and to overcome resistance in the ducts and outlets downstream from mixing box.
- E. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume dual-duct systems, and adjust each mixing-box maximum- and minimum-airflow settings.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, variable-air-volume terminal units shall be calibrated by pitot tube traverse in the branch duct prior to the terminal.
- C. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Set outside-air dampers at minimum and return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.
- D. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 1. Balance systems similar to constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.

3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
- E. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.8 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at full flow through the cooling coil if coil has that capacity.
- B. Adjust each zone damper to indicated airflow.

3.9 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.

2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.10 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus five percent of design.
- B. If pump flow does not equal terminal flows, close a percentage of valves to simulate diversity.
- C. Set calibrated balancing valves, if installed, at calculated presettings.
- D. Measure flow at all stations and adjust, where necessary, to obtain first balance. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- E. Measure flow at main balancing station and set main balancing device to achieve flow that is five percent greater than indicated flow.
- F. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- H. Measure the differential-pressure control valve settings existing at the conclusion of balancing.

3.11 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.12 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

- A. Balance the primary system crossover flow first, and then balance the secondary system.

3.13 PROCEDURES FOR STEAM SYSTEMS

- A. Measure and record upstream and downstream pressure of each piece of equipment.
- B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
- C. Check the setting and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record the final setting.
- D. Check the settings and operation of each safety valve. Record settings.
- E. Verify the operation of each steam trap.

3.14 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check the setting and operation of safety and relief valves. Record settings.

3.15 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.16 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
 6. Capacity: Calculate in tons of cooling.
 7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.17 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
1. Measure condenser-water flow to each cell of the cooling tower.
 2. Measure entering- and leaving-water temperatures.
 3. Measure wet- and dry-bulb temperatures of entering air.
 4. Measure wet- and dry-bulb temperatures of leaving air.
 5. Measure condenser-water flow rate recirculating through the cooling tower.
 6. Measure cooling tower pump discharge pressure.
 7. Adjust water level and feed rate of makeup-water system.

3.18 PROCEDURES FOR BOILERS

- A. If hydronic, measure entering- and leaving-water temperatures and water flow.
- B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.

3.19 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
 7. Air pressure drop.
- B. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.

3.20 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure outside-air, wet- and dry-bulb temperatures.

3.21 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

- A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- B. After balancing is complete, do the following:
 1. Measure and record the static pressure at the hood exhaust-duct connection.
 2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches (300 mm) between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
 3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
- C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
 1. Check duct slopes as required.
 2. Verify that duct access is installed as required.
 3. Verify that point of termination is as required.
 4. Verify that duct air velocity is within the range required.
 5. Verify that duct is within a fire-rated enclosure.
- D. Report deficiencies.

3.22 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

- A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.

- B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
- C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
 - 1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
 - 2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
 - 3. Test room pressurization first, then zones, and finish with building pressurization.
- D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.
- E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
 - 1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
 - 2. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.
- F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
- G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

3.23 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the condition of filters.
 - 4. Check the condition of coils.
 - 5. Check the operation of the drain pan and condensate drain trap.
 - 6. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow and water flow rates by more than five percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If five percent or less, equipment adjustments are not required.
4. Air balance each air outlet.

3.24 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.25 PROCEDURES FOR DOMESTIC WATER MEASUREMENTS

- A. Balance recirculation lines to values shown on plans
- B. Record flow rates for reach circuit setter.

3.26 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.27 FINAL REPORT

- A. General: Computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB firm who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer, type size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.

- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat coil static-pressure differential in inches wg (Pa).
 - g. Cooling coil static-pressure differential in inches wg (Pa).
 - h. Heating coil static-pressure differential in inches wg (Pa).
 - i. Outside airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outside-air damper position.
 - l. Return-air damper position.
- G. Apparatus-Coil Test Reports:
1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Face area in square feet (sq. m).
 - d. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outside-air, wet- and dry-bulb temperatures in degree F (degree C).
 - e. Return-air, wet- and dry-bulb temperatures in degree F (degree C).
 - f. Entering-air, wet- and dry-bulb temperatures in degree F (degree C).
 - g. Leaving-air, wet- and dry-bulb temperatures in degree F (degree C).
 - h. Water flow rate in gpm (L/s).
 - i. Water pressure differential in feet of head or psig (kPa).
 - j. Entering-water temperature in degree F (degree C).
 - k. Leaving-water temperature in degree F (degree C).

- H. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Motor horsepower and rpm.
 - g. Motor volts, phase, and hertz.
 - h. Motor full-load amperage and service factor.
 - i. Sheave make, size in inches (mm), and bore.
 - j. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).

 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Entering-air temperature in degree F (degree C).
 - c. Leaving-air temperature in degree F (degree C).
 - d. Air temperature differential in degree F (degree C).
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btuh (kW).
 - i. High-fire fuel input in Btuh (kW).
 - j. High-temperature-limit setting in degree F (degree C).
 - k. Operating set point in Btuh (kW).
 - l. Motor voltage at each connection.
 - m. Motor amperage for each phase.

- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches (mm), and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).

2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 - g. Number of belts, make, and size.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in degree F (degree C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in square feet (sq. m).
 - g. Indicated airflow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual airflow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary airflow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final airflow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in degree F (degree C).
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Entering-water temperature in degree F (degree C).
 - c. Leaving-water temperature in degree F (degree C).
 - d. Water pressure drop in feet of head or psig (kPa).
 - e. Entering-air temperature in degree F (degree C).
 - f. Leaving-air temperature in degree F (degree C).
 3. Pump Test Data (Indicated and Actual Values):
 - a. Voltage at each connection.
 - b. Amperage for each phase.
 - c. Water flow rate in gpm (L/s).
 4. Water Test Data (Indicated and Actual Values):
 - a. Entering-water temperature in degree F (degree C).
 - b. Leaving-water temperature in degree F (degree C).
 - c. Water temperature differential in degree F (degree C).
 - d. Entering-water pressure in feet of head or psig (kPa).
 - e. Leaving-water pressure in feet of head or psig (kPa).
 - f. Water pressure differential in feet of head or psig (kPa).
 - g. Water flow rate in gpm (L/s).
 - h. Bleed water flow rate in gpm (L/s).
 5. Air Data (Indicated and Actual Values):
 - a. Duct airflow rate in cfm (L/s).
 - b. Inlet-duct static pressure in inches wg (Pa).
 - c. Outlet-duct static pressure in inches wg (Pa).
 - d. Average entering-air, wet-bulb temperature in degree F (degree C).
 - e. Average leaving-air, wet-bulb temperature in degree F (degree C).
 - f. Ambient wet-bulb temperature in degree F (degree C).
 6. Primary Water Test Data (Indicated and Actual Values):
 - a. Entering-water temperature in degree F (degree C).
 - b. Leaving-water temperature in degree F (degree C).
 - c. Entering-water pressure in feet of head or psig (kPa).
 - d. Water pressure differential in feet of head or psig (kPa).
 - e. Water flow rate in gpm (L/s).
 7. Secondary Water Test Data (Indicated and Actual Values):
 - a. Entering-water temperature in degree F (degree C).
 - b. Leaving-water temperature in degree F (degree C).
 - c. Entering-water pressure in feet of head or psig (kPa).
 - d. Water pressure differential in feet of head or psig (kPa).
 - e. Water flow rate in gpm (L/s).
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm (L/s).
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches (mm).
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches (mm).
 - d. Full-open flow rate in gpm (L/s).
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).
 - h. Final total pressure in feet of head or psig (kPa).
 - i. Final water flow rate in gpm (L/s).
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- N. Boiler Test Reports:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and type.
 - e. Model and serial numbers.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
 2. Test Data (Indicated and Actual Values):
 - a. Operating pressure in psig (kPa).
 - b. Operating temperature in degree F (degree C).
 - c. Entering-water temperature in degree F (degree C).
 - d. Leaving-water temperature in degree F (degree C).
 - e. Safety valve settings in psig (kPa).
 - f. High-limit setting in psig (kPa).
 - g. Operating-control setting.
 - h. High-fire set point.
 - i. Low-fire set point.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
 - l. Draft fan voltage at each connection.

- m. Draft fan amperage for each phase.

3.28 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least five percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Measure space pressure of at least 10 percent of locations.
 - e. Verify that balancing devices are marked with final balance position.
 - f. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by [Owner] [Architect].
2. TAB firm test and balance engineer shall conduct the inspection in the presence of [Owner] [Architect].
3. [Owner] [Architect] shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal eight-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.29 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

3.30 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start of TAB.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 05 90

SECTION 23 07 00

HVAC INSULATION 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: Insulation materials and accessories.
- B. New Work: Completely insulate all new work as specified and scheduled.
- C. Existing Work:
 - 1. Insulate all existing piping and ductwork where existing insulation is damaged, as if it is new piping or ductwork.
 - 2. Insulate all existing piping and ductwork that is currently not insulated, as if it is new piping or ductwork.
- D. Coordination:
 - 1. Coordinate size and location of supports, hangers, and insulation shields specified in other sections.
 - 2. Coordinate clearance requirements with piping installer for piping insulation application, duct installer for duct insulation application, and equipment installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
 - 3. Coordinate installation and testing of heat tracing.

1.3 SUBMITTALS

- A. Product Data: Submit for each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings:
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 field application for each equipment type.
 9. Make reference to applicable specification paragraph numbers (of the items discussed above) for coordination.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23, Section 230500, "Common Work Results for HVAC."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for 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 before installation of insulation.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Thermal Requirements for all Insulation: Insulation thickness, conductivity (k) value and/or R-value shall be as required by the local energy code or as indicated, whichever is greater.

2.2 PIPE INSULATION

- A. Glass Fiber Preformed Pipe Insulation: Glass fiber meeting ASTM C547, rigid molded. "K" value 0.23 at 75°F. Maximum service temperature shall not exceed 850°F. Jacket shall be high density, white Kraft bonded to aluminum foil for vapor barrier, reinforced with fiberglass yarn, permanently treated, secured with self-sealing longitudinal laps and butt strips or AP jacket with outward clinch expanding staples coated with vapor barrier mastic.
 - 1. For interior use only. Do not use on exterior piping.
 - 2. Basis of Design: Johns Manville "Micro-Lok HP."
 - 3. Manufacturers:
 - a. Johns Manville "Micro-Lok HP."
 - b. Knauf Insulation "Earthwool 1000 Pipe Insulation."
 - c. Owens-Corning "Fiberglas SSLII-ASJ."
 - 4. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- B. Polyisocyanurate Preformed Pipe Insulation: Rigid molded polyisocyanurate pipe insulation shall meet the requirements of ASTM C591 Type IV. Materials shall have a minimum thermal conductivity of 0.19 Btu-in. per sq.ft. per °F per hour at a mean temperature of 75°F when tested in accordance with ASTM C177 or ASTM C518, latest revisions. Maximum service temperature shall not exceed 300°F. The pipe insulation shall include a vapor retarder jacket with self-sealing longitudinal laps.
 - 1. Basis of Design: HiTherm HT-300.
 - 2. Manufacturers:
 - a. HiTherm HT-300.
 - b. Other Polyisocyanurate manufacturers shall be allowed only if they meet fire and smoke rating requirements for the specified thicknesses.
 - 3. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- C. Phenolic: Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
 - 1. Basis of Design: Resolco; Insul-Phen.
 - 2. Manufacturers:
 - a. Dyplast Products; DyTherm.
 - b. ITW Insulation Systems; Trymer Supercel.

- c. Resolco; Insul-Phen.
 3. Field-Applied Jacket: Requirements are specified in "Field-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- D. Calcium Silicate Pipe Insulation (Use only for inserts for fiber glass insulation at pipe supports): Rigid molded pipe insulation, asbestos-free, meeting ASTM C533, color coded throughout, "K" value 0.40 at 300°F, maximum service temperature 1200°F, minimum compressive strength of block form not less than 200 psi with 5% compression at 1-1/2" thickness. Non-combustible tested per ASTM E-136. Secured with 16-gauge stainless steel tie wire with twisted ends on maximum 12-inch centers.
 1. Basis of Design: Johns Manville "Thermo-12 Gold."
 2. Manufacturers:
 - a. Johns Manville "Thermo-12 Gold."
 - b. Industrial Insulation Group "Super Caltemp Gold."
 3. Field-Applied Jacket: Requirements are specified in "Field-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- E. Cellular Glass Pipe Insulation: Inorganic, closed cell, all glass, non-combustible with 0.2% (by volume) moisture absorption. Average density of 8 lb./cu. ft., 100 psi compressive strength, 900°F service temperature, 0.35 BTU/in./hr/sf/°F conductivity.
 1. Basis of Design: Pittsburgh Corning "Foamglas One."
 2. Manufacturers:
 - a. Cell-U-Foam Corporation "Ultra-CUF".
 - b. Pittsburgh Corning "Foamglas One."
 3. Field-Applied Jacket: Requirements are specified in "Field-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.
- F. EPDM rubber, flexible, closed-cell elastomeric insulation in tubular or sheet form. The product will meet the requirements defined in ASTM C 534.
 1. Basis of Design: Armacell LLC; AP Armaflex.
 2. Manufacturers:
 - a. Aeroflex USA Inc.; Aerocel AC, Aerocel White/Gray, Aerocel-SSPT, Aerocel W/G-SSPT, or Aerocel SA.
 - b. Armacell LLC; AP Armaflex.
 - c. Industrial Thermo Polymers Limited; Tundra Seal.
 3. EPDM elastomeric insulation shall have a flame-spread index of 25 or less and a smoke-developed index of 50 or less when tested in accordance with ASTM E 84, for all products through 2" thickness.
 4. Product to be suitable for use from -297 F to 300 F continuous service temperature, per ASTM C 411.
 5. EPDM elastomeric insulation shall have a maximum thermal conductivity of 0.245 Btu-in./h-ft²F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518.
 6. Field-Applied Jacket: Requirements are specified in "Field-Applied Jackets" Article.
 - a. Preformed Pipe Insulation: ASJ.

2.3 EQUIPMENT AND DUCTWORK INSULATION

- A. Thermal Requirements for all Equipment Insulation: Insulation thickness and/or R-value shall be as required by the local energy code or as indicated, whichever is greater.
- B. Glass or Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Basis of Design: CertainTeed Corp.; SoftTouch Duct Wrap.
 2. Manufacturers:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite XG.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; Softr Duct Wrap FRK.
- C. Glass or Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Basis of Design: CertainTeed Corp.; CertaPro Commercial Board.
 2. Manufacturers:
 - a. CertainTeed Corp.; CertaPro Commercial Board.
 - b. Johns Manville; 1000 Series Spin-Glas.
 - c. Knauf Insulation; Insulation Board.
 - d. Owens Corning; Fiberglas 700 Series.
- D. Cellular Glass Insulation: Inorganic, closed cell, all glass, non-combustible with 0.2% (by volume) moisture absorption. Average density of 8 lb./cu. ft., 100 psi compressive strength, 900°F service temperature, 0.35 BTU/in./hr/sf/°F conductivity, R-value = 3.44 per inch.
1. Basis of Design: Pittsburgh Corning "Foamglas One."
 2. Manufacturers:
 - a. Cell-U-Foam Corporation "Ultra-CUF".
 - b. Pittsburgh Corning "Foamglas One."
 3. Field-Applied Jacket: Requirements are specified in "Field-Applied Jackets" Article.
 - a. Block Insulation: ASTM C 552, Type I.
 - b. Special-Shaped Insulation: ASTM C 552, Type III.
 - c. Board Insulation: ASTM C 552, Type IV.
 - d. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

2.4 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
1. Basis of Design: 3M; Fire Barrier Duct Wrap 615 Plus.
 2. Manufacturers:

- a. CertainTeed Corp.; Fyre Wrap Max 2.0.
- b. Johns Manville; Firetemp SL-2.0 Wrap.
- c. 3M; Fire Barrier Duct Wrap 615 Plus.

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:
- B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
- C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
- D. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
- E. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 1. Manufacturers:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
- F. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 1. Manufacturers:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
- G. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 1. Manufacturers:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.6 FIELD APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

- C. Jacketing of Ducts and Pipes Exposed to Weather: All ductwork and piping exposed to weather shall be finished with an aluminum jacket over the insulation. Aluminum jacket material shall be embossed or corrugated sheet, 0.016" nominal thickness, conforming to ASTM B209, temper H-14. Jacketing shall be applied with joints lapped not less than 2", and shall be secured with 3/8" x 0.020" thick aluminum bands located at each circumferential lap and at not more than 9" intervals throughout. Horizontal joints shall lap downward to shed water. Vertical joints shall be sealed with weatherproof silicone sealant.
1. Basis of Design: Childers Products, Division of ITW "Metal Jacketing Systems."
 2. Manufacturers:
 - a. Childers Products, Division of ITW.
 - b. Pabco Metals Corporation.
 - c. RPR Products Inc, "Insul-Mate".
- Be careful to consider jacketing requirements for piping that may be outdoors, but not exposed to weather. Such piping may include piping in parking garages, within covered loading docks, etc. Make sure documents adequately address different requirements for different situations.
- D. PVC Plastic: One-piece molded type fitting covers and jacketing material, gloss white. Connections, tacks, pressure sensitive color matching vinyl tape. PVC material shall be 25 flame spread and 50 smoke development rated per ASTM E-84.
1. Basis of Design: Johns Manville "Zeston 2000 PVC".
 2. Manufacturers:
 - a. Johns Manville "Zeston 2000 PVC".
 - b. Proto Engineered Thermoplastcs Corp. "Proto Fitting Cover System".
 - c. P.I.C. Plastics, Inc.; FG Series.
 - d. Speedline Corporation "Smoke-Safe".
- E. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure sensitive, acrylic-bases adhesive covered by a removable protective strip.
1. Basis of Design: Dow Chemical Company Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder tape.
 2. Manufacturers:
 - a. Dow Chemical Company Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder tape.
- F. Underground Cellular Glass Pipe Jacket: The underground direct buried jacket shall be 125-mil thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
1. Basis of Design: Pittsburgh Corning "Pittwrap CW Plus" with "Pittcoate 300."
 2. Manufacturers:
 - a. Pittsburgh Corning "Pittwrap CW Plus" with "Pittcoate 300."
 - b. Polyguard "Insulrap No Torch 125".
- G. Canvas Jacket: UL listed fabric, 6 oz/sq.yd.plain weave cotton treated with dilute fire retardant lagging adhesive. Manufacturer: Great Lakes Textiles Product Style 1979.
- H. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

- I. Butt Straps: Materials shall be identical in all respects and appearance to the basic jacket material.

2.7 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 1. Basis of Design: P. K. Insulation Mfg. Co., Inc.; "Super-Stik".
 2. Manufacturers:
 - a. Insulco, Division of MFS, Inc.; "Triple I"
 - b. P. K. Insulation Mfg. Co., Inc.; "Super-Stik".
 - c. Ramco Insulation, Inc.; "Supertemp 1900".
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement 100 to 1200 degree: Comply with ASTM C 449/C 449M.
 1. Basis of Design: P. K. Insulation Mfg. Co., Inc" PK No. 127" and "Quik-Cote".
 2. Manufacturers:
 - a. Insulco, Division of MFS, Inc.; "SmoothKote".
 - b. P. K. Insulation Mfg. Co., Inc.; "Quik-Cote".
 - c. Ramco Insulation, Inc.; "Ramcote 1200".
 - d. Rock Wool Manufacturing Company; "Delta One Shot".

2.8 ADHESIVES AND MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated. Obtain insulation and/or jacket manufacturer approval for all adhesives and mastics used. Obtain A/E approval for all locations where mastics will be used.
 1. Adhesives shall not be considered an acceptable alternative to specified mechanical fastening methods without prior A/E approval.
 2. All adhesives and mastics shall be suitable for the moisture conditions and temperatures that will be encountered.
- B. Cellular-Glass Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
 1. Basis of Design: Childers Products, Division of ITW; CP-96.
 2. Manufacturers:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Basis of Design: Armacell LCC; 520 Adhesive.
 2. Manufacturers:
 - a. Aeroflex USA Inc.; Aeroseal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Basis of Design: Childers Products, Division of ITW; CP-82.
 2. Manufacturers:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Marathon Industries, Inc.; 225.
 - d. Mon-Eco Industries, Inc.; 22-25.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Basis of Design: Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 2. Manufacturers:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Solvent Weld Adhesive.
- F. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Basis of Design: Childers Products, Division of ITW; CP-35.
 2. Manufacturers:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. Marathon Industries, Inc.; 590.
 - d. Mon-Eco Industries, Inc.; 55-40.
 3. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 4. Service Temperature Range: Minus 20 to plus 180 deg F.
 5. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 6. Color: White.
- G. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Basis of Design: Childers Products, Division of ITW; CP-10 and CP-11.
 2. Manufacturers:
 - a. Childers Products, Division of ITW; CP-10, CP-11.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. Marathon Industries, Inc.; 550.
 - d. Mon-Eco Industries, Inc.; 55-50.
- 2.9 SEALANTS
- A. Joint Sealants: Joint Sealants for Cellular-Glass, and Polyisocyanurate Products:
1. Basis of Design: Mon-Eco Industries, Inc. "44-05".
 2. Manufacturers:
 - a. Childers Products, Division of ITW; "CP-76".
 - b. Foster Products Corporation "30-45N".
 - c. Mon-Eco Industries, Inc. "44-05".
 - d. Pittsburgh Corning Corporation Pittseal "444".

- B. FSK and Metal Jacket Flashing Sealants: Materials shall be compatible with insulation materials, jackets, and substrates. Fire- and water-resistant, flexible, elastomeric sealant. Minus 40 to plus 250 degree F service temperature range. Color shall be aluminum.
1. Basis of Design: Mon-Eco Industries, Inc. "44-05".
 2. Manufacturers:
 - a. Childers Products, Division of ITW; "CP-76-8".
 - b. Foster Products Corporation "95-44".
 - c. Mon-Eco Industries, Inc. "44-05".
- C. ASJ Flashing Sealants, and PVDC, and PVC Jacket Flashing Sealants. Materials shall be compatible with insulation materials, jackets, and substrates. Fire- and water-resistant, flexible, elastomeric sealant. Minus 40 to plus 250 degree F service temperature range. Color shall be white.
1. Manufacturer:
 - a. Childers Products, Division of ITW; "CP-76".
 - b. Foster Products Corporation "95-44".
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc. "44-05".

2.10 TAPES

- A. ASJ Tape: White, 3-inch wide, vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Basis of Design: Compac Corp. "104 and 105".
 2. Manufacturers:
 - a. Avery Dennison Corporation, Specialty Tapes Division "FT 2150".
 - b. Compac Corp. "104 and 105".
 - c. Ideal Tape Co., Inc., an American Biltrite Company; "428 AWF ASJ".
 - d. Venture Tape; "1540 CW Plus, 1542 CW Plus", and "1542 CW Plus/SQ".
- B. FSK Tape: Foil-face, three-inch wide, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Basis of Design: Compac Corp. "110 and 111".
 2. Manufacturers:
 - a. Avery Dennison Corporation, Specialty Tapes Division "Fasson 0827".
 - b. Compac Corp. "110 and 111".
 - c. Ideal Tape Co., Inc., an American Biltrite Company; "491 AWF FSK".
 - d. Venture Tape; "1525 CW Plus, 1528 CW Plus", and "1542 CW Plus/SQ".
- C. PVC Tape: White, 2-inch wide, vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Basis of Design: Compac Corp. "130".
 2. Manufacturers:
 - a. Avery Dennison Corporation, Specialty Tapes Division "Fasson 9200".
 - b. Compac Corp. "130".
 - c. Ideal Tape Co., Inc., an American Biltrite Company; "370 White Pvc".
 - d. Venture Tape; "1506 CW NS".

- D. PVDC Tape for Indoor Applications: White, three-inch wide, vapor-retarder PVDC tape with acrylic adhesive. Manufacturer: Dow Chemical Company "Saran 540 Vapor Retarder Tape".
- E. PVDC Tape for Outdoor Applications: White, three-inch wide, vapor-retarder PVDC tape with acrylic adhesive. Manufacturer: Dow Chemical Company "Saran 560 Vapor Retarder Tape".

2.11 SECUREMENTS

- A. Bands:
 - 1. Manufacturers:
 - a. Childers Products.
 - b. Gerrard & Co.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

PART 3 - EXECUTION

3.1 MINIMUM INSULATION SCHEDULE

- A. Fiberglass insulation shall not be used outdoors.
- B. Duct insulation:
 - 1. Supply within unconditioned spaces (above ceilings, within shafts and within mechanical rooms): R-6.
 - a. 2" thick, 0.75 lb/cu.ft. mineral or glass fiber blanket.
 - b. 1-1/2" thick, 2.25 lb/cu.ft. mineral or glass fiber board.
 - 2. Supply and return outside the building envelope: R-12.
 - a. 4" thick, 0.75 lb/cu.ft. mineral or glass fiber blanket.
 - b. 3" thick, 2.25 lb/cu.ft. mineral or glass fiber board.
 - 3. Return, relief, and exhaust within the building envelope, upstream of shut-off dampers: none required.
 - 4. Outside air intake: within conditioned space, downstream of automatic isolation damper: R-7.
 - a. 2.2" thick, 0.75 lb/cu.ft. mineral or glass fiber blanket.
 - b. 2" thick, 2.25 lb/cu.ft. mineral or glass fiber board.
 - 5. Outside air intake: within conditioned space upstream of automatic isolation damper.
 - a. 6.0 lb/cu.ft. mineral or glass fiber board, R-value shall equal roof or wall values.
 - 6. Supply, return, outside air intake, not within conditioned space in concrete or below grade: Minimum R-5.3.
 - a. 2" 7.3 lb/cu.ft. cellular glass.
- C. Heating water piping, chilled water piping, steam piping and steam condensate piping:

Fluid Operating Temperature Range and Usage (°F)	Insulation Conductivity		Nominal Pipe or Tube Size in Inches (a)				
	Conductivity Btu·in./(h·ft ² ·°F)	Mean Rating Temperature, °F	< 1	1 to < 1 ½	1 ½ to ≤ 4	4 to < 8	≥ 8
> 350	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
40 – 60	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
<40	0.20 – 0.26	75	0.5	1.0	1.0	1.0	1.5

- a. For piping smaller than 1 ½ inch (38 mm) and located in partitions within conditioned spaces, reduction of these thickness by 1 inch shall be permitted but not to a thickness less than 1 inch.

D. Service Schedule:

System	Operating Temp. (°F)	Material
Low Pressure Steam (0-15 psig)	212-250	Glass-Fiber Cellular Glass Polyiso. or Phenolic Calcium Silicate
Medium Pressure Steam (16-125 psig)	251-349	Glass-Fiber Cellular Glass Calcium Silicate
High Pressure Steam (126-245 psig)	350-399	Glass-Fiber Cellular Glass Calcium Silicate
Steam Condensate, Hot Service Drains	<250	Glass-Fiber Cellular Glass Polyiso. or Phenolic Calcium Silicate
Hot Service Vents	212-250	Glass-Fiber Cellular Glass Polyiso. or Phenolic Calcium Silicate
Heating Water	120-180	Glass-Fiber Cellular Glass

		Polyiso. or Phenolic Elastomeric
Chilled Water	40-60	Glass-Fiber Cellular Glass Polyiso. or Phenolic Elastomeric

Notes:

1. Polyisocyanurate allowed only if it meets fire and smoke rating requirements at this thickness.
 2. Use Calcium Silicate only for inserts at pipe saddles and hangers
- E. Outdoor Cooling Tower/Condenser Water Pipe Insulation: Cellular Glass, Polyisocyanurate or Phenolic; 2 inch with aluminum jacket (polyisocyanurate allowed only if it meets fire and smoke rating requirements at this thickness).
- F. Equipment; provide the following on any equipment that is not factory insulated:
1. Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, condenser bundles, heat-recovery bundles, suction piping, compressor inlets, tube sheets, water boxes, and nozzles with one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Mineral-fiber board, phenolic or polyisocyanurate: 1 inches thick.
 2. Steam-to-hot-water converter insulation shall be one of the following:
 - a. Cellular Glass: 6 inches thick.
 - b. Mineral-fiber pipe and tank, phenolic or polyisocyanurate: 4-1/2 inches thick.
 3. Chilled-water expansion/compression tank and air separator insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Mineral-Fiber pipe and tank: 1 inch thick.
 - c. Phenolic or Polyisocyanurate: 1 inch thick.
 4. Heating-hot-water expansion/compression tank and air separator insulation shall be one of the following:
 - a. Mineral-Fiber pipe and tank: 2 inch thick.
 - b. Phenolic or Polyisocyanurate: 1-1/2 inch thick.
 5. Steam condensate tank and receiver insulation shall be one of the following:
 - a. Phenolic or polyisocyanurate: 2 inches thick.
 - b. Mineral-Fiber pipe and tank: 2-1/2 inches thick and 3-lb/cu. ft. nominal density.
 6. Steam flash-tank, flash-separator, and blow-off-tank insulation shall be one of the following:
 - a. Cellular Glass: 6 inches thick.
 - b. Mineral-fiber pipe and tank, phenolic or polyisocyanurate: 4-1/2 inches thick.
 7. Chilled-water pump insulation shall be[one of] the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Mineral-Fiber board: 1 inch thick.

- c. Phenolic or Polyisocyanurate: 1 inch thick.
- 8. Heating-hot-water pump insulation shall be one of the following:
 - a. Mineral-Fiber board: 2 inch thick.
 - b. Phenolic or Polyisocyanurate: 1-1/2 inch thick.
- 9. Steam condensate pump and boiler feedwater pump insulation shall be the following:
 - a. Phenolic or polyisocaynurate: 2 inches thick.
 - b. Mineral-Fiber Board: 2-1/2 inches thick and 3-lb/cu. ft. nominal density.
- 10. Insulation on chilled water pumps:
 - a. Fabricate metal boxes lined with insulation. Insulation shall be as indicated above for specific service. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 - b. Fabricate boxes from galvanized steel, at least 0.050 inch thick.
 - c. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.
 - d. Box and insulation shall not be required on small fractional HP in-line pumps.
 - e. A neoprene wrap is an acceptable alternative to a box.
- G. Valves and pipe fittings shall be insulated as indicated below.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application. 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 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 between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 INSULATION WORK IN GENERAL

- A. General: Except as specified, material shall be installed in accordance with the recommendations of the manufacturer.
 - 1. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

2. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
3. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
4. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
5. Install insulation with least number of joints practical.
6. Install insulation with longitudinal seams at top and bottom of horizontal runs.
7. Do not apply insulation until surfaces to be covered have been leak tested, have had rust and scale removed, and have been cleaned, dried and inspected.
8. Insulation shall be kept dry and clean at all times.
9. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
10. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - a. Install insulation continuously through hangers and around anchor attachments.
 - b. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - c. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - d. 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.
 - e. Continue insulation vapor barrier through penetrations except where prohibited by code.
11. Continue pipe insulation through gypsum and masonry walls only if fire stopping specified in Division 07 has a UL Listed assembly that includes a jacketed insulation. Coordinate with General Contractor.
12. Install insulation with factory-applied jackets as follows:
 - a. Draw jacket tight and smooth.
 - b. 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.
 - c. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - d. For below ambient services, apply vapor-barrier mastic over staples.
 - e. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - f. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
13. All work shall be performed at ambient and equivalent temperatures as recommended by the manufacturers.
14. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
15. Joints shall be staggered on multi-layer insulation.
16. Do not apply insulation until heat tracing specified elsewhere in other sections of this Specification is completed and tested.

17. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces.
18. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

3.4 INSULATION INSTALLATION, PIPING

- A. General: Pipe insulation shall be installed in strict conformance to the manufacturer's recommendations. Pipe insulation shall be continuous and installed on all fittings and appurtenances unless specified otherwise. Installation shall be with full-length units of insulation and using a single-cut piece to complete a run. Provide jackets for all pipe insulation.
- B. Insulation Installation on Straight Pipes and Tubes:
 1. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 2. Secure laps with outward clinched staples at six inches o.c, for insulation with factory-applied jackets on above ambient surfaces.
 3. Do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant, for insulation with factory-applied jackets on below-ambient surfaces.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with **wire or** bands.
- D. Polyisocyanurate Insulation:
 1. All insulation shall be tightly butted and free of voids and gaps. Vapor retarder, if used, must be continuous. All fasteners and bands shall be neatly aligned.
 2. In below-ambient systems, staple, rivets, screws and other fasteners capable of penetrating the vapor retarder shall not be used.
 3. Install prefabricated insulation fittings on elbows, tees, and valves. Insulation at fittings shall be the same type and thickness as on straight pipe sections.
 4. Lap joints of vapor retarder jacket shall be sealed using SSL tape or manufacturer's vapor retarder tape.
 5. Elbows and fittings shall be wrapped with vapor retarder tape in a spiral fashion, using a 50% overlap between successive courses of tape.
- E. Unions, Flanges, Couplings, Strainers, and Valves:
 1. Insulate all fittings, flanges, couplings, strainers, valves (and similar accessories) associated with an insulated piping system unless indicated otherwise.
 2. Exposed Work: On exposed work, insulate to a diameter equal to insulation of adjacent piping provided a minimum of 0.75" of insulation is maintained around fittings, couplings, strainers and valves, otherwise, increase diameter.
 3. Concealed Work: On concealed work, increase insulation diameter to maintain same insulation thickness as on adjacent piping. Use same material as specified for adjacent piping; fitting covers to be as specified hereinafter.

4. Adjustable and Serviceable Valves and Accessories: Where balancing valves, strainers and similar devices are adjustable or require servicing on less than a five-year cycle, provide removable insulation sections. Where valves with repackable glands and similar devices allow service, but manufacturer does not anticipate service frequency to be less than five years, make reasonable provisions to allow removal and reinstallation of the same materials with minimal effort and potential for damage.
- F. Thermometer and Test Wells: Insulate test thermometer, industrial thermometer, and other test wells over their exterior length. Insulate thermometer wells protruding above finish pipe or equipment insulation. Neatly taper insulation away from top of well. Insulation on thermometer wells shall be 1-1/2" minimum thickness.
- G. Insulation Support at Hangers:
1. Provide support shield and 360 degree insert between support shield and piping on piping 1-1/2" diameter and larger. Fabricate insert from heavy density insulating material suitable for the temperature. Shield shall be fabricated of 14 gauge galvanized sheet metal. Insulation shields and inserts shall be not less than the following lengths:

1/2" to 2-1/2"	10"
3" to 6"	12"
8" to 10"	16"
 2. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with lagging adhesive for vapor seal. Where anchors are secured to insulated chilled piping, insulate anchors same as piping for a distance not less than four times insulation thickness to prevent condensation.
- H. Sleeves and Wall Chases: Insulation on pipes through walls and floors shall be full size and jacketed same as adjacent insulation. Provide a metal jacket over the insulation on pipe passing through sleeves in non-fire rated walls where caulking is required.
1. Where penetrating interior walls, extend the metal jacket two inches out on either side of the wall and secure on each end with a band.
 2. Provide adequate support on vertical pipe to prevent slipping.
- I. Allowances for Movement: At points where pipe will move during expansion and contraction (expansion joints, Z-bends, expansion loops, etc.), clearances between the pipe and encased insulation shall be sized to permit full pipe movement without cracking or damaging insulation and casing or jacket.
- J. Insulation at Mechanical Pipe Couplings: PVC insulated fitting covers shall be applied after the installation is installed. Installation shall comply with the manufacturer's recommended procedures. Connection with the pipe insulation shall be done in a neat, finished appearance, and any required vapor barrier shall be maintained.
- K. Insulation Within Reach of Building Occupants: Where insulation is within reach of building occupants and visitors, insulation surfaces shall be protected by smooth sheet aluminum jacket material, 0.016" nominal thickness, lapped, banded, and installed same as above. The term "within reach" is defined as within ten feet of the floor, except for cases where there is reasonable protection (in the opinion of the A/E) offered by objects located between the insulation and the floor. This does not apply to insulation concealed within wall or ceiling construction and insulation located within equipment rooms that can be locked off from the normal building occupants.

3.5 SPECIAL PIPE INSULATION REQUIREMENTS:

- A. Removable Insulation Sections: Installation shall conform to the following:
1. Fabricate removable insulation sections from sections of pipe insulation or block insulation as follows. Removable flexible blankets will be allowed with prior approval if adequate covering is provided. Vapor barrier must be maintained for cold surfaces.
 2. When covers are made from sectional pipe insulation, extend insulation at least two times the insulation thickness over adjacent pipe insulation on each side of the component. Secure cover in place with stainless-steel hooks and wire.
 3. When covers are made from block insulation, make two halves, each consisting of mitered blocks. Extend insulation at least two inches over adjacent pipe insulation on each side of the component. Fill space between the component and pipe insulation with insulating cement.

3.6 DUCTWORK AND PLENUM INSULATION INSTALLATION

- A. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
- B. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
- C. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
1. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space three inches maximum from insulation end joints, and 16 inches o.c.
 2. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and three inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 3. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 4. Do not over-compress insulation during installation.
 5. Impale insulation over pins and attach speed washers.
 6. 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.
- D. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing two inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, one inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 2. Install vapor stops for ductwork and plenums operating below 50 degree F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness but not less than three inches.
- E. Overlap unfaced blankets a minimum of two inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

- F. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- G. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with six-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced six inches o.c.

3.7 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Glass Fiber Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 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 insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 - 5. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 - 6. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

3.8 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. Terminate insulation above roof surface and seal with joint sealant for applications requiring only indoor insulation. Install insulation for outdoor applications tightly joined to indoor insulation ends for applications requiring indoor and outdoor insulation. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. Terminate insulation inside wall surface and seal with joint sealant for applications requiring only indoor insulation. Install insulation for outdoor applications tightly joined to indoor insulation ends for applications requiring indoor and outdoor insulation. Seal joint with joint sealant.
 - 3. Seal jacket to wall flashing with flashing sealant.

- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Floor, Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated floors, walls and partitions if firestop is rated for this approach. Obtain further direction from A/E if firestopping is not rated for insulated penetrations. Comply with requirements in **Division 07 Section** for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. General: Where field-applied jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with two-inch overlap at seams and joints.
 - 2. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where metal jackets are indicated, install with two-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 07 00

SECTION 23 08 00

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. The purpose of this section is to specify the Division 23 responsibilities and participation in the commissioning process. See Division 1, Section 01 91 00, "Commissioning," for Contractor-related commissioning requirements.
1. Organization of the commissioning program is primarily the responsibility of the Commissioning Authority. Execution of the program is primarily the responsibility of the Contractor with support from the Division 23 contractor for:
 - a. Testing and start-up of the mechanical equipment.
 - b. Completion and endorsement of pre-functional test checklists provided by the Commissioning Authority to assure that Division 23 equipment and systems are fully operational and ready for functional testing.
 - c. Providing qualified personnel to assist the Commissioning Authority with functional testing to verify equipment/system performance.
 - d. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
 - e. Providing training for the systems specified in Division 23 with coordination of Owner by the Commissioning Authority.
- B. Division 23 Contractor shall cooperate with the Commissioning Authority in the following manner:
1. Allow sufficient time before final completion dates so that test and balance, controls point-to-point checkout, and functional testing can be accomplished.
 2. Provide labor and material to make corrections when required without undue delay.
 3. Put all heating, ventilating, and air conditioning systems and equipment into full operation, and continue the operation of the same during each working day of commissioning.
- C. Related Sections
1. Section 01 91 00 – Commissioning
 2. Division 22 – Plumbing
 3. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC)
 4. Division 26 – Electrical

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Standard certified test equipment for commissioning will be provided by the Commissioning Authority.

- B. Proprietary test equipment required by the manufacturer shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.

PART 3 - EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

- A. Specific pre-commissioning responsibilities of Division 23 are as follows:
 - 1. Normal start-up services required to bring each system into a fully operational state. This includes motor rotational check, cleaning, filling, purging, control sequences of operation, leak testing, full-load and part-load performance, etc.
 - 2. Normal testing, adjusting and balancing services required to verify each system is operating at design capacities.
 - 3. Complete pre-functional test checklists for all equipment and systems to be commissioned.
 - 4. Demonstrate system readings as requested by the Commissioning Authority and adjust units to achieve specified operation.
 - 5. Factory start-up services for key equipment and systems specified in Division 23. The Division 23 Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.

3.2 PARTICIPATION IN COMMISSIONING

- A. The Division 23 Contractor shall provide skilled technicians to start-up and debug all systems within the Division 23 work (particularly with controls equipment). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed upon schedules, and of sufficient duration to complete the necessary tests, adjustments and/or problem resolutions.
- B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.
- C. Provide skilled technicians to manipulate the following equipment and systems to be commissioned for functional testing:
 - 1. Heating water system
 - 2. Air supply, exhaust, relief and ventilation system
 - 3. Terminal cooling and heating system
 - 4. Automated control systems

3.3 WORK TO RESOLVE DEFICIENCIES

- A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet Acceptable Performance. Correction of work will be completed under the direction of the Architect, with input from the Contractor, Equipment Supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Architect/Engineer-of-Record will have final jurisdiction on the necessary work to be done to achieve performance and/or design intent.

3.4 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

- A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes with a fully occupied building. The Contractor will be responsible to participate in the initial and the alternate peak season test of the systems required demonstrating performance.
- B. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. The Contractor will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

3.5 TRAINING

- A. The Division 23 Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each mechanical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.

END OF SECTION 23 08 00

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SECTION 23 09 00

INSTRUMENTATION AND CONTROLS 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.
- B. Division 23, Section 230500, "Common Work Results for HVAC" is directly related to work included in this section. Other sections are indirectly related and shall be reviewed.

1.2 SUMMARY

- A. A complete Energy Management and Control System (EMCS) shall be provided to control and/or to monitor building systems as outlined in the sequences of operation, drawings and this specification. The EMCS shall employ direct digital control (DDC).
 - 1. Provide all software, hardware and cabling necessary for communication between operator stations, controllers, sensors, actuators and other devices.
 - 2. Provide all miscellaneous software, wiring, parts and labor required in establishing a complete and working system that is an interoperable network capable of communicating with the existing EMCS.

1.3 APPROVED MANUFACTURERS

- A. Provide an HVAC control system with distributed processing units, input/output units, firmware and standard operating software.
 - 1. Design, component selection, installation, custom programming, documentation, testing, training and warranty service shall be the direct responsibility of the manufacturer or their local representative.
 - 2. New equipment and software shall be selected for compatibility with systems that might be presently installed at the site.

1.4 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.5 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within eight seconds.
 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
 6. Program Execution Frequency: Run capability of applications as often as five seconds but selected consistent with mechanical process under control.
 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus one degree F.
 - b. Water Flow: Plus or minus five percent of full scale.
 - c. Water Pressure: Plus or minus two percent of full scale.
 - d. Space Temperature: Plus or minus one degree F.
 - e. Ducted Air Temperature: Plus or minus one degree F.
 - f. Outside Air Temperature: Plus or minus two degrees F.
 - g. Dew Point Temperature: Plus or minus three degrees F.
 - h. Temperature Differential: Plus or minus 0.25 degrees F.
 - i. Relative Humidity: Plus or minus five percent.
 - j. Airflow (Pressurized Spaces): Plus or minus three percent of full scale.
 - k. Airflow (Measuring Stations): Plus or minus five percent of full scale.
 - l. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - m. Air Pressure (Space): Plus or minus 0.01-inch wg.
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
 - o. Carbon Monoxide: Plus or minus five percent of reading.
 - p. Carbon Dioxide: Plus or minus 50 ppm.
 - q. Electrical: Plus or minus five percent of reading.

1.6 SUBMITTALS

- A. Provide a complete set of reproducible control drawings using computer aided design and drafting (CADD) technology. Include the following information:
1. Show general physical arrangement of component devices installed in the panels. Indicate applicable detailed drawing reference.
 2. Provide a typical schematic drawing of each control circuit.
 3. Identify equipment and devices by the reference designations shown on the drawings and by unique point identification used in system software. Provide material list with or on each drawing.
 4. Supply block diagrams and schematics showing riser diagrams, the layout of equipment, communication cabling, and wire type.
 5. Provide system diagrams showing the general mechanical system layout with all sensors/devices of each mechanical system.
 6. Supply floor plan drawings showing the location of all controlled equipment and devices used for sensing and control.

7. Provide a schematic drawing of each control circuit, complete with individual wire identifications. Typical drawings are acceptable.
 8. Provide LAN truck riser diagram showing cable routing and location of all repeaters.
- B. Provide sequences of operation detailing all control strategies, including initial setpoints and referencing all points by the point name used in the BAS programming. These sequences of operation shall also be provided in the record drawings.
- C. Provide a complete list of equipment to be furnished, which includes a manufacturer's catalog sheet for each item on the material list.
1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
 4. Provide a damper schedule with one line per damper. Provide for each damper: The project TAG, the size, the model of the damper, the type and model of the actuator, and whether the damper fails open, closed, or in place.
 5. Provide a valve schedule with one line per valve. Provide for each valve: The project TAG, the size, the model of the valve, the pressure rating, the model and type of the actuator, the valve Cv, and whether the valve fails open, closed, or in place.
- D. Provide a test plan describing the procedures used to complete and document the "Owner-witnessed Testing" described in the Final Acceptance requirement.
1. Test plans shall include a schedule for tracking each phase of the testing, e.g. zone testing by floor, fan testing by system, chiller interface testing, heating system testing, etc.
 2. The vendor is required to supplement the planned work effort to meet the progress dates given in the schedule.
 3. Show initial setpoints.
 4. Provide all documentation necessary to interpret programming related submittals.
- E. As part of the submittal process, the vendors shall meet with representatives of the Owner's engineering and operations divisions, giving them a thorough briefing on the BAS programming design. This briefing shall describe in detail the methods the control programmer has used to meet the requirements of the sequence of operations.
- F. Submit the point-to-point (PTP) and sequence-of-operation verification test plans for acceptance prior to the scheduled beginning of testing. PTP testing shall be part of the construction schedule.
- G. Asbestos-Free Materials: The contractor shall submit asbestos-free documents (MSDS and/or, manufacturer certification,) to certify that all suspect asbestos containing materials as defined in the Puget Sound Clean Air Agency, Regulation III, Article 4 to be used in construction are asbestos-free.
- H. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.

1.7 QUALITY ASSURANCE

- A. All materials and equipment used shall be new, standard components, regularly manufactured and not custom-designed or fabricated specifically for this project.
- B. All components and software shall have been previously tested and proven in regular use. Minimum in-use requirements are 24 months for hardware and 12 months for major software (whole number revision) releases.
- C. Modularity. The HVAC control system shall possess a modular architecture, permitting expansion through the addition of more distributed processing units, input/output units, sensors, actuators and operator stations.
- D. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASHRAE 135 for DDC system components.
- G. System Software: Update to latest version of software at Project completion.
- H. Approval - Vendor shall submit and receive approval for all submittals including materials, floor plan, schematics and programming prior to installation.

1.8 COORDINATION

- A. Coordinate location of thermostats, carbon dioxide sensors, and other exposed control sensors with plans, owner, or owner's representative, Division 26, and room details before installation.
- B. Coordinate equipment with Division 26 and Division 28, Section 28 31 11, "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.
- C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- D. Coordinate equipment with Division 26:
 - 1. Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
 - 2. Section 260913, "Panelboards" to achieve compatibility with starter coils and annunciation devices.
 - 3. Section 262419, "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

1.9 FINAL ACCEPTANCE REQUIREMENTS

- A. Provide corrected documentation to show changes made to correct deficiencies discovered during commissioning tests. Reassemble manuals and drawing packages to reflect corrected documentation records.
- B. Drawings and software:
 - 1. Submit shop drawings reflecting final "as-built" condition.

- a. Provide record drawings on owners preferred version of AutoCAD. Deliver two copies of data on two Flash drives.
 - b. Provide 3 copies of reproducible record drawings.
 - c. These record drawings shall accurately depict the final as-built conditions and shall be on Architectural/Mechanical backgrounds provided by the A/E.
 - d. These drawings shall include accurate depiction of location of sensors and controlled equipment (motor starters, valves, chillers, dampers, AHUs, etc.)
 - e. Insert one copy of applicable shop drawings, panel layout drawing, and points list at each enclosure's documentation holder.
 - f. Furnish one original set of application software on flash drives. Disks shall bear the manufacturer's label. Field copies are not acceptable. Application software includes operating system, controls application generation, graphic support, maintenance support and all other utilities provided in support of the installed system.
- C. Operation and Maintenance (O&M) Manuals: Provide two paper copies of material required and five copies on flash drives in MS Word format. Describe operation, maintenance and servicing requirements of the HVAC control system and associated equipment. Provide the following information in separate sections, each with an index.
1. Technical literature for all equipment, including catalog sheets, calibration, adjustments and operation instructions, and installation instructions
 2. Hardware and software manuals, including information supplied by the original product developer, on the application programs and on the computers and controllers provided by vendor
 3. System description and complete sequence of operation
 4. Reduced size (11" x 17") copies of record drawings
 5. Input/Output (I/O) summary forms for the system, listing all connected analog and binary input and output functions and the number and types of points. Indicate spare input/output capacity
 6. Control programs specific to this system
 7. Completed point-to-point checkout plan used in Owner-witnessed testing, and the completed data sheets showing the results of the point-to-point testing.
- D. Owner-Witnessed Testing
1. All parts of the testing described in this section are to be performed as point-to-point tests and control sequence verification. The Owner may choose to have this testing witnessed by a member of the Owner's staff, by an independent commissioning agent, by a member of the A/E team, or otherwise.
 - a. One copy of the preliminary as-built documents shall be provided to support this testing.
 - b. After receipt of all system documentation by the Owner, notify Owner 10 working days before testing begins.
 - c. Testing shall be performed by the manufacturer or its local representative. The procedure for the test must provide a format for documenting the results, comments, vendor repair activity, vendor's initials, and retest witnessing. Provide data sheets with one line for each physical point on the system, and columns to record the results, dates, and initials of witnesses for both pretests and witness tests.
 - d. The Contractor shall perform point-to-point pretests before the witnessed tests and shall fill out data sheets during pretests to demonstrate successful performance prior to witnessed tests.
- E. Installation verification tests:
1. Verify operation, location and identification of power sources, including circuit breakers and control power transformers.

2. Start/stop points: Issue start and stop commands from an operator station. Verify that controlled equipment responds appropriately and that the start/stop status is accurately reflected at the operator station.
 3. Analog points: Analog inputs and outputs shall be verified at both extremes of their ranges and at the midpoint. Verify tight shutoff and full opening of dampers and valves.
 4. Binary points: Verify that both commanded conditions (on/off, open/closed, etc.) are accurately reflected at the operator station.
 5. Test fan and pump failure alarms by turning off the motor at the HOA switch and observing the run-state indication at the operator station.
 6. Temperature points: Verify calibration of sensors by comparing displayed temperature values with the reading of an independent measuring device located in the same flow. Test liquid temperature sensors as installed in piping thermowells to verify effectiveness of heat conducting compound.
 7. Pressure points: Verify calibration of sensors by comparing displayed pressure with the reading of an independent measuring device located in the same flow stream. Retain the services of the balancer as required to confirm readings.
 8. Control valves: Verify tight shutoff by comparing water or air temperatures entering and leaving the heat transfer device.
 9. Operator response and sequencing: Demonstrate that sequenced or modulated valves and dampers position accurately in response to posit multiple operators to provide simultaneous modulation of parallel dampers or valve assemblies.
 10. Control signal stability, general: Demonstrate that control loops are tuned so that the output does not change until the controlled system has had time to respond to the last output signal.
 11. Control signal stability, response to step input: Demonstrate that control loops are tuned so that they are stable without excessive hunting following a step input of not less than 20% of the operating/reset range of the controlled variable.
 12. Control signal stability, floating point devices: Verify that minimum pulse output duration is no less than the value required to assure repositioning of the controlled device.
 13. Demonstrate the capability of the controls system to execute the complete sequence of operation as given in the mechanical design documents.
 14. Verify tight shut-off of all actuated control valves (for three-way valves, demonstrate capacity for 100% by-pass of coil).
- F. Operator station tests:
1. Override test: Verify manual override capability for start/stop and modulated point types.
 2. Control logic:
 - a. Exercise all control logic packages.
 - b. Check response to upset, change in setpoint.
 3. Supervisory function:
 - a. Verify content of time clock schedules.
 - b. Verify alarm's reporting capabilities.
 4. Failure modes:
 - a. Verify all stand-alone operation by disconnecting communication lines between stand-alone control units and verifying continued operation.
 - b. Disconnect and reconnect controller power to confirm proper recovery from power failure (sample).
- G. Other software tests:
1. Trend logging
 2. Report generation
 3. Remote access

4. Test the ability of the control system to automatically restart all the connected systems following a power restoration and fire alarm recovery.

1.10 SERVICE AND GUARANTEE

- A. The complete control system shall be warranted to be free of defects in manufacturing, workmanship and materials for one year. Temperature sensor accuracy shall be warranted for three years. Software and documentation shall be revised to reflect system changes required to meet warranty obligations.
- B. During the warranty period, provide a 24-hour emergency service telephone number where a qualified service technician, familiar with the installed system, may be reached.
 1. This technician shall have the capability of remote communication with the control system for troubleshooting and program alterations.
 2. The vendor shall pay all costs to provide communications for remote access.
 3. A fully equipped, qualified repair technician shall be at the job site within four hours of a request for emergency service.
- C. All replacement parts must be available on site within 48 hours during the term of the warranty.
- D. Provide free of charge during the warranty period four DDC software sequence modifications (up to 24 hours engineering time) as instructed by the Owner. Modification shall be in software only.

1.11 POST-INSTALLATION TRAINING AND MATERIALS

- A. The manufacturer and control contractor shall train operating personnel (FOMs) in the operation and maintenance of the system as follows:
 1. The controls subcontractor shall provide the Owner's system operators complete training for proper control of the system under all modes of operation. These modes shall include but not be limited to summer/winter, energy management and alarm event sequences. The training shall be conducted during normal working hours, Monday through Friday at the job site. Training shall consist of both classroom and hands-on training. Provide a minimum of 4 hours of on-site training for a total of three people. Provide each trainee with a copy of the sequence of operations and the graphics during each training session. Training will be refined based on the successful bidder and may address the following subjects:
 - a. Sensor/actuator operation.
 - b. System architecture and basic theory of operation.
 - c. Operator level (password level 1) interface to system for password access, alarm handling, point addressing, manual commands and statistical data acquisition.
 - d. Program level (password level two) operation for command control and definition of energy management parameters.
 - e. Configuration level (password level three) for all database entry and modification.
 - f. Review of sequence of operations.
 - g. System troubleshooting.
 - h. Emergency service support.
 - i. Fire alarm interface.
 - j. System restart after power failure.
 - k. Replacement procedures of each system component.
 - l. Calibration and initialization procedures.
 - m. Regeneration procedures on all installed programming at operator's control stations.
 2. Provide one each of the following:

- a. Complete reference materials (manuals) that would be used by a factory trained master technician
 - b. Test instruments, and software manufactured or modified by the manufacturer for use in the installation, troubleshooting, and repairs of installed devices. Include unique portable test terminal, test boxes, circuit card extenders, calibration modules, etc.
3. The Owner will be allowed to video tape any or all of the training sessions.
- B. Provide all of the training and materials that a control contractor service employee would receive in order to become a Master Technician. Training and materials will be provided for three Owner representatives on separate schedules. Provide a complete description of this training with the submittals. Include the cost of training, travel, lodging and transportation between lodging, airport and training location.
- 1.12 SYSTEM COMMISSIONING
- A. Provide assistance, staff and materials to support the commissioning activities.
 1. This includes all testing apparatus in use by the BAS contractor to test and calibrate or verify calibration of the control system.
 2. Assistance includes but is not limited to reviewing test procedures and providing software enhancements to accommodate testing methods.
 - B. Provide staff and materials to support the point-to-point testing, also referred to as Owner-witnessed Testing and described under Final Acceptance Requirements.
 - C. Operate the control system for any commissioning tests specified in other specification sections.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide as required for a complete and operating building automation system, all software, hardware, input/output devices, wiring and control power not shown in electrical bid documents, actuated dampers, actuated valves, actuators, operation and maintenance training, special maintenance tools and aids, supervision of labor, and warranty.
- B. The system shall be built only of standard components kept in stock by the supplier.
 1. All replacement parts shall be available on site within 48 hours.
 2. The components shall not require customizing other than setting jumpers and switches, or adding firmware or software modules, or on-site software programming to do required functions.
- C. System display should meet the following requirements:
 1. The system is to be fully menu-driven.
 2. All system titles, prompts, and instructions are to be in the English language.
 3. All entries to be in natural units, i.e., a setpoint value shall be entered in its actual control unit of value, such as 74° F.
 4. The primary means of information display and system management shall be by graphic display. Use the same style of display as is currently used throughout the facility.
 5. Each display will contain comment sections to indicate area served (if area-specific) and contain a graphical presentation for all other interlocked systems.

2.2 BASIC SYSTEM FEATURES

- A. Zone-by-zone control of space temperature, usage scheduling, and equipment failure reporting (A zone is the area served by one HVAC terminal unit, fan coil, heat pump, air terminal, etc.)
- B. For all controllers and other devices that do not automatically and immediately resume normal operation after loss of power and then restoration of power, provide Werner Electric Stabiline UPS (Uninterruptable Power Supply) model SW1500 (or approved equal having five year battery life and battery hot swappable capability) for all cabinets having a mounting area over 120 square inches and containing controllers. These cabinets shall be provided with a fused duplex receptacle to be used a source for UPS power. Cabinet shall draw power from the UPS. Provide shelf for UPS.
- C. All control power shall be provided from 120 VAC emergency power sources located in the "low voltage" closets on each floor and in the mechanical rooms.
- D. Tamper-proof room wall mounted sensors installed with Allen, Bristol or similar hardware with local temperature setpoint adjustment (limited range). The maximum allowed temperature range shall be set from an operator's station. Program the local control ranges as follows:
 - 1. Standard thermostats - 70°F to 75°F
 - 2. Mechanical and electrical rooms - 50°F to 85°F
- E. Space temperature control in specifically identified locations will use return/exhaust duct mounted sensors and setpoint will be adjusted with computer interface.
- F. Individually assignable priority password security system to prevent unauthorized use. Provide at least four levels including the following: Information only, change of setpoint & ON/OFF, programmer, and a fourth master level for assigning appropriate local access.
- G. Equipment monitoring and alarm function including information for diagnosing equipment problems.
 - 1. All system points shall be programmed to report alarm conditions by fully expanded point names that are tailored and specific to this project.
 - 2. Assign alarm limits at 10% above highest expected level and at 10% below lowest expected level (subject to control sequence design) or as requested by Owner.
 - 3. Interlock all alarm points to system status to lock out alarms when the system is not operational by schedule or operator command.
- H. Auto-restart, without operator intervention, the operator stations and all controlled equipment to the control state that would be in effect if the power failure or fire alarm event had not occurred. Start/stop outputs shall continue to command the affected device while motor power is unavailable and allow for equipment restart, as previously commanded or scheduled, upon restoration of motor power.
- I. Equipment run-time totalization of motor driven equipment.
- J. Interactive displays of all input and output points: As a minimum, each screen on the monitor shall be able to display 25 interactive points and custom text.
- K. Operator shall be able to, through keyboard interface, disable any control logic for any output or setpoint, temporarily substitute the value for any input/output, and introduce a different value or state for all inputs, outputs and setpoints.

- L. Individual controllers shall be programmed with nonvolatile stand-alone control logic necessary to maintain appropriate HVAC equipment operation. While in temporary stand-alone mode, energy efficiency can be sacrificed to maintain temperature control and operational conditions that will not damage equipment or compromise health and safety.
- M. Controllers shall, upon loss of valid programming, be capable of requesting and receiving a programming download of all required program code from the system management server.
- N. Owner personnel shall be able to create and modify control software in any facility computer utilizing menu-driven programming. Owner personnel shall be able to store the programming on a removable computer disk and preprogram a nonvolatile, transportable memory storage device, which can be used for replacement of the programming in system controllers.

2.3 SYSTEM ARCHITECTURE

- A. The BAS shall consist of a network of controllers providing full stand-alone operation of the building. The controllers shall contain the necessary programming to accomplish the sequence of operations for building control.
- B. Controllers shall normally execute the control strategy to use peer-to-peer communication capabilities. Upon loss of communication, the stand-alone control unit shall be able to execute its own stand-alone programming. This distribution of control authority is mandated so that the lost communications capability shall not cause a complete loss of control for affected systems.
- C. Operator station shall not be necessary to sustain building operation.
- D. All EMCS equipment installed in this project shall be interoperable to interface with the existing campus EMCS. All control products provided for this project shall comprise a BACnet internetwork.
- E. The Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the internetwork.
- F. All controllers shall have a communication port for connections with the operator interfaces using the BACnet Data Link/Physical layer protocol.
- G. Communication services over the internetwork shall result in operator interface and value passing that is transparent to the internetwork architecture as follows:
 - 1. Connection of an operator interface device to any one controller on the internetwork will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the internetwork.
 - 2. All database values (e.g., objects, software variables, custom program variables) of any one controller shall be readable by any other controller on the internetwork. This value passing shall be automatically performed by a controller when a reference to a object name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communication services to perform internetwork value passing.

- H. Dedicated Controllers: All sensing points and controlled outputs associated with a sub-system or piece of equipment shall be wired to and processed within one controller. A sub-system is defined as a group of equipment items that are directly controlled together, such as the components associated with an air handler. A "reset" signal may come from another subsystem controller. When supply terminal units are to be tracked by an exhaust terminal unit, all supply and exhaust monitoring and control points shall be processed by the same controller.

2.4 GRAPHICS

- A. General: Provide complete graphics for all systems. Graphic completeness, appearance and quality shall be the best available from the approved manufacturer. All system shall be diagrammed in the graphics with measured values indicated at the appropriate location on the diagrammatic graphic. Setpoint, on-off-auto and similar adjustable shall be at the appropriate location on the diagrammatic graphic.
- B. Graphic display requirements:
1. Provide a Microsoft Windows-based software package for the preparation of system graphics.
 2. Include with this software a library of HVAC symbols such as fans, pumps, chillers, etc.
 3. This section establishes standards for graphic displays as follows:
 - a. All operator stations shall be programmed to display dynamic color graphic representations of the mechanical systems and floor areas for which this system has control.
 - b. Systems to be displayed include the air handlers (including all monitored and controlled components), air terminal units, fans, chillers and towers, heat converters and exchangers, pumping systems and similar mechanical devices.
 - c. Show the mechanical equipment components on a single graphic. Example: Chilled and condenser water pumps, cooling towers, chillers, differential pressure control valves, etc.
 - d. Displays shall automatically update with current real time data.
 - e. Room floor plan displays are required and shall indicate the approximate positions of controlled mechanical system elements.
 - f. All displays shall show real time data to include temperatures, actuator positions, and motor run status.
 - g. All system input, output and setpoint points shall be displayed on an appropriate graphic.

2.5 DDC EQUIPMENT

A. OPERATOR STATIONS

1. Local Access: Operator interface with the installed EMCS equipment and the entire campus BAS shall be performed with portable computers and desktop computers using site licensed software.
2. WEB Access: It shall be possible to interface with the EMCS from remote computers equipped with Microsoft Internet Explorer (web browser) via the Internet.
 - a. Operators shall be able to access information through user interfaces at the application controller and the plant controller levels, as well as at the master display.
 - b. System shall be an open, interoperable system supporting LonWorks®, BACnet® and/or other protocols.
3. Operator interface with the EMCS includes the ability to operate and program all campus EMCS equipment. The ability to look, adjust/override and program will be controlled using access levels.

4. Overall management of the EMCS, storage of programs, data, trends, access control, graphics.
 5. Application Software:
 - a. I/O capability from operator station.
 - b. System security for each operator via software password and access levels.
 - c. Automatic system diagnostics; monitor system and report failures.
 - d. Database creation and support.
 - e. Automatic and manual database save and restore.
 - f. Dynamic color graphic displays with up to 10 screen displays at once.
 - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
 - h. Alarm processing, messages, and reactions.
 - i. Trend logs retrievable in spreadsheets and database programs.
 - j. Alarm and event processing.
 - k. Object and property status and control.
 - l. Automatic restart of field equipment on restoration of power.
 - m. Data collection, reports, and logs. Include standard reports for the following:
 - 1) Current values of all objects.
 - 2) Current alarm summary.
 - 3) Disabled objects.
 - 4) Alarm lockout objects.
 - 5) Logs.
 - n. Custom report development.
 - o. Utility and weather reports.
 - p. Workstation application editors for controllers and schedules.
 - q. Maintenance management.
 6. Custom Application Software:
 - a. English language oriented.
 - b. Full-screen character editor/programming environment.
 - c. Allow development of independently executing program modules with debugging/simulation capability.
 - d. Support conditional statements.
 - e. Support floating-point arithmetic with mathematic functions.
 - f. Contains predefined time variables.
- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
 3. Standard Application Programs:
 - a. Coordinate

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
- D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (four to 20 Ma).
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined one percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least three seconds without failure.
- F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.6 UNITARY CONTROLLERS

- A. Each controller shall operate as part of the control system and as an independent unit when not in communication with other controllers or an operator station. Global controllers shall be able to share Global information on a peer-to-peer basis without relying on an operator station.

- B. It shall be possible to define control strategies at each controller from any operator station. Each controller shall be able to interface directly with an operator station.
- C. Each controller shall include its own microprocessor, power supply, and, if necessary, battery with automatic charger. Upon loss of system power, the controller memory shall be maintained for a minimum of 72 hours with no external source of power. Upon restoration of system power, the control unit shall resume full operation without operator intervention.
- D. Provide control programming logic at each controller for proportional and/or proportional plus integral control capabilities as necessary to assure complete and stable control of each controlled variable.
- E. Each controller shall maintain and perform its own stand-alone control strategy upon communications failure. The controller stand-alone control program shall be adequate to maintain the basic control function and provide protection from inappropriate equipment operation. The controller shall retain its programming during a power failure and resume operation without program reloading from another device.
- F. The controllers shall be powered by 24 VAC.
- G. Each controller shall be isolated (optically or by other means) from communication trunk and have fuse or overload protection.
- H. The controller point monitoring and control capabilities shall include but not be limited to the following:
 - 1. Binary inputs (contact closures)
 - 2. Analog inputs (use only resistive, 0-10 volt, and 4-20 ma. inputs; provide A/D conversion of 10 bits, minimum)
 - 3. Binary output (start/stop or latching and momentary contacts)
 - 4. Floating point control
 - 5. Analog outputs (must include 4-20 ma. @ 10 VDC minimum, 0 -10 VDC; provide A/D conversion of 12 bits, minimum).
 - 6. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.

2.7 ALARM PROGRAM

- A. For each alarm input, provide the following assignable alarm responses:
 - 1. Display English language point description in addition to system point identification.
 - 2. Print out alarm description and operator-created alarm message.
 - 3. Require acknowledgment by operator and print occurrence if directed by Owner.

2.8 LOGS

- A. Trend log: As a minimum, provide capacity for 50 trend logs. Provide for review of data on monitor and printer. Each trend log shall have assignable start/stop times/dates.
- B. Current alarm log: Display all points currently in alarm. Operator activity log: Record operator activity by operator account identification and work performed during a minimum of the last 10 log-in sessions or last 20 commands.

2.9 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70-degree F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig.

2.10 FAILURE MODE

- A. Upon failure of any global controller, the operator station shall display off-line occurrence for each affected point and provide communication verification to each controller for each I/O channel.
- B. In the event of communication failure, controller shall continue to operate equipment using appropriate backup values for missing global information. If sensor information is necessary for proper stand-alone function, then that sensor shall be attached directly to the appropriate controller. Provide failure mode programming to accomplish safe operation of equipment in case of communications failure on local trunk.
- C. Upon return of primary power after a power failure of up to 72 hours, the system shall automatically return to completely normal operation with no action required from operating personnel.
- D. Unless otherwise indicated in the design documents, provide the following failure modes, (that is, the position that the controlled device attains under failure due to loss of power, loss of air pressure, or loss of communications) for valves and dampers:
 - 1. All Fan cooling water valves shall fail closed.
 - 2. All central cooling water differential pressure control valves shall fail closed.
 - 3. All fan exhaust air and outside air dampers shall fail closed.
 - 4. All fan recirculation dampers shall fail open.
 - 5. Zone-level air terminal unit dampers may fail in place.

2.11 ENERGY REDUCTION AND SPECIAL OPERATION SOFTWARE

- A. The system shall be designed to control energy-consuming loads. Provide engineering, consulting, and programming to develop and set up the following energy reduction software:
 - 1. Time schedules: Software should provide at least 16-time schedules. Each schedule is to be an 8-day type, capable of six entries minimum per day. Time program shall provide ON/OFF commands and reset SETPOINT capabilities.
 - 2. Holiday time programs: Provide a holiday time schedule capability.

3. Optimal start/stop: Provide the ability to optimize start/stop times to attain and maintain temperature setpoint only during occupied times. The system shall be self tuning, with compensation for weekends and holidays.
4. Setpoint reset: Provide a means of automatically resetting heating water, chilled water and ventilation air temperatures, volumes and pressures.
5. Provide a program to automatically restart all DDC controlled equipment upon the resumption of power or return from fire alarm condition. Equipment shall be restarted according to a prearranged, prioritized and staggered restart schedule.
6. For loads that have been turned off at the Motor Control Center, either by positioning of the HOA switch or the line disconnect; provide a restart strategy that automatically restarts load upon the reset of switches to their normal on-line positions.
7. Provide capability to adjust the setpoints of main mechanical systems from an operator station using simple 'point and click' command windows.

2.12 ELECTRONIC SENSORS

A. Temperature sensors:

1. Sensors shall be completely pre-calibrated with no electrical adjustments or calibration required for standard installation conditions.
2. The temperature displayed at an operator station shall be accurate to within 1° F. This accuracy shall be warranted (parts and labor) for a minimum of three years.
3. Wall-mounted sensors shall be tamperproof. Wall mounted sensors for zone controls shall provide jack for operations laptop connection. That connection shall allow communication with system for monitoring and adjusting at least the zone-level equipment serving that zone. Wall sensors shall include temperature readout and shall provide basic control sequence diagnostic and reset features and local setpoint adjust and after-hours override
4. Freeze protection sensors shall be non-averaging.
5. Thermowells shall be bronze, brass, or stainless steel with 1-inch NPT threads.
6. Install piping temperature sensors adjacent to temperature gauge or test port.
 - a. Use heat-conducting compound in thermowells.
 - b. Strap-on fluid temperature sensors will not be allowed.
7. Mount outside air sensors inside the outside air intake as to avoid solar influence and directly sense the average temperature of the air entering the air handling unit(s).

B. Air velocity transmitter: Shall provide air velocity information independent of the effects of static pressure. Transmitter shall operate at rated accuracy from 0° F to 120° F. The minimum accuracy of displayed value at an operator station shall be 95% through the range of 20% to 100% of sensed airflow, with a drift rate no greater than one percent per year. The proportional output shall be 4 to 20 mA.

C. Differential and static pressure transmitter: Transmitter shall operate from 50% of minimum to 150% of maximum anticipated pressure. The maximum error of displayed value at an operator station shall be 2% through the range of 20% to 150% of the intended maximum setpoint. Minimum pressure tolerance shall be 150% of the maximum pressure expected in normal operation. The maximum drift rate shall be no greater than one percent per year. The proportional output shall be 4 to 20 ma. Provide designed pressure pitot sensor Dwyer type A-301/A 302 or approved equal.

D. Current sensors shall convert AC to proportional DC (4 to 20 ma). Response time: 300 milliseconds to 99% of final value. Manufacturer: Neilson-Kuljian or approved equal. Controls will be programmed to indicate equipment failure if motor current goes above or below normal conditions.

- E. Averaging elements shall be mounted so as to cross a minimum of 80% of the plenum width and shall be located to provide an indication of temperature within +/- 1° F. Provide support at 36 inches maximum such that there will be no metal to metal contact between the sensing element and other equipment.
- F. Outside air sensors shall be a waterproof assembly protected from solar radiation. Span shall cover the range of 0° F to 100° F or better and not exceed a 150° F span. Typically, mount sensor inside an outside air intake that draws air 24/7.
- G. Pressure Transmitters/Transducers:
 - 1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: Two percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
 - d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
 - e. Manufacturer:
 - 1) Tek-air Systems Inc., Ultra low series
 - 2) Setra Systems
 - 3) Veltron
 - 4) Modus "low flow T" series
 - 5) Ultratech Inc.
 - 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
 - 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA.
 - 4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential. Manufacturer:
 - a. Tek-air Systems Inc., Ultra low series
 - b. Veltron
 - c. Modus "low flow T" series
 - d. Ultratech Inc
 - 5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

2.13 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter: Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and one percent full-scale accuracy.

- E. Power Monitor: Three-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

2.14 THERMOSTATS

- A. Thermostats shall be low-voltage, thermistor sensor, touch screen operated, with 55 to 85-degree F set-point range, minimum. Thermostats shall be programmed so the user can adjust temperature higher or lower a pre-determined range (coordinate range with owner). A 5-degree deadband between heating and cooling shall be programmed.

2.15 GAS DETECTION EQUIPMENT

- A. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 degree F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting. Manufacturer: Ventostat model 8001.
- B. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.16 ELECTRONIC AIRFLOW MEASUREMENT STATIONS:

- A. Ebtron Model GTC116 or approved equal. Thermal dispersion airflow measurement. UL listed, airflow accuracy +/- 2% of reading, 6063 gold anodized aluminum probe, 304 ss brackets, RS-485 output with BACnet MS/TP.
- B. General
 1. Provide one airflow measurement device (AMD) for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate and temperature at each measurement location.
 2. Each AMD shall be provided with a microprocessor-based transmitter and one or more sensor probes.
 - a. Devices that have electronic signal processing components on or in the sensor probe are not acceptable.
 3. Airflow measurement shall be field configurable to determine the average actual or standard mass airflow rate.
 - a. Actual airflow rate calculations shall have the capability of being adjusted automatically by the transmitter for altitudes other than sea level.
 4. Temperature measurement shall be field configurable to determine the velocity weighted temperate or simple arithmetic average temperature.
- C. Sensor Probes
 1. Sensor probes shall be constructed of gold anodized, 6063 aluminum alloy tube [insert 316 stainless steel tube in lieu of 6063 aluminum alloy tube, when required].
 2. Sensor probe mounting brackets shall be constructed of 304 stainless steel.

3. Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper.
 - a. PVC jacketed internal wiring is not acceptable.
4. Probe internal wiring connections shall consist of solder joints and spot welds.
 - a. Connectors of any type within the probe are not acceptable.
 - b. Printed circuit boards within the probe are not acceptable.
5. Probe internal wiring connections shall be sealed and protected from the elements and suitable for direct exposure to water.
6. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67°F to 392°F and continuous and direct UV exposure.
 - a. Plenum rated PVC jacket cables are not acceptable.
7. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.
8. Each sensor probe shall contain one or more independently wired sensing nodes.
9. Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter.
10. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy.
 - a. Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.
11. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
12. Each sensor node shall be individually calibrated to NIST-traceable airflow standards at a minimum of 16 calibration points.
13. The number of independent sensor nodes provided shall be as follows:

Area ft ²	# Sensor Nodes	Area ft ²	# Sensor Nodes
≤ 0.5	1	> 4 & ≤ 8	8
> 0.5 & ≤ 1	2	> 8 & ≤ 12	12
> 1 & ≤ 2	4	> 12 & ≤ 14	14
> 2 & ≤ 4	6	> 14	16

- a. A total of 4 probes shall be required for openings with an aspect ratio ≤ 1.5 and with an area ≥ 25 ft².

D. Transmitter

1. A remotely located microprocessor-based transmitter shall be provided for each measurement location.
2. The transmitter shall be comprised of a main circuit board and interchangeable interface card.
3. All printed circuit board interconnects, edge fingers, and test points shall be gold plated.
4. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.
5. All receptacle plug pins shall be gold plated.
6. The transmitter shall be capable of determining the average airflow rate and temperature of the sensor nodes.
 - a. Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).

7. The transmitter shall be capable of providing a high and/or low airflow alarm.
8. The transmitter shall be capable of identifying an AMD malfunction via the system status alarm and ignore any sensor node that is in a fault condition.
9. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.
 - a. The airflow rate, temperature, airflow alarm and system status alarm shall be visible on the display.
10. The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals and [select one or both of the following] one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection; or one isolated RS-485 (field selectable BACnet MS/TP or Modbus TRU) network connection; or one isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection.
11. Analog output signals shall provide the total airflow rate and be field configurable to output one of the following:
 - a. temperature
 - b. airflow alarm; or
 - c. system status alarm
12. Network communications shall provide the average airflow rate, temperature, airflow alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures.
13. Provide an infra-red I/O card mounted on the transmitter PCB for communication to a handheld retrieval device that can download individual sensor node airflow and temperature data in real time.
14. The transmitter shall be powered by 24 VAC and use a switching power supply that is over-current and over-voltage protected.
15. The transmitter shall use a "watchdog" timer circuit to ensure continuous operation in the event of brown-out and/or power failure.

E. Performance

1. Each sensing node shall have an airflow accuracy of $\pm 2\%$ of reading over an operating range of 0 to 5,000 FPM.
 - a. Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.
 - b. Devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter shall demonstrate compliance with this requirement over the entire operating range.
2. Each sensing node shall have a temperature accuracy of $\pm 0.15^\circ$ F over an operating range of -20° F to 160° F.

F. Listings and Certifications

1. The AMD shall be UL873 Listed as an assembly.
 - a. Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.
2. The AMD shall be BTL Listed.
3. The AMD shall carry the CE Mark for European Union Shipments.

2.17 ACTUATORS

- A. Actuator type: Electronic actuators shall be used for all water control valves and air dampers.

- B. Electronic actuators shall be Belimo, Delta, or approved equal selected from the vendor's standard product line.
 - 1. Sized for torque required for damper seal at load conditions.
 - 2. All electronic actuators shall be powered by 24 VAC (smoke damper are powered by 120 volts as per specification 233300).
 - 3. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 4. Proportional electronic actuators shall use 0 to 10 VDC, 4 to 20 mA. or floating-point control.
 - 5. Floating point actuators shall have position indicated by potentiometer so control system will know exact position at all times.
 - 6. Temperature Rating: Minus 22 to plus 122-degree F, (Minus 22 to plus 250-degree F for smoke dampers).
 - 7. Multiple electronic actuators may be powered by one separately fused 24 VAC transformer, providing the transformer size does not exceed 100 VA.
 - 8. No more than two electronic actuators may drive a common shaft.
 - 9. All electronic actuators shall have field manual positioning capability to allow manual positioning of valve or damper in absence of control power.
 - 10. Two integral built-in auxiliary end switches.
 - 11. Actuator shall have positioning feedback.
- C. Actuators shall be capable of providing 150% of the minimum valve or damper manufacturer's published torque requirements for complete shutoff.
- D. Actuators shall 'Fail in Last Position' unless otherwise noted.
- E. Valve actuators shall have clutch and manual positioning handle/wheel at all locations where a separate isolation valve is not provided immediately adjacent to the controlled valve.

2.18 CONTROL VALVES

- A. Control valves shall be selected to meet CV and pressure requirements.
 - 1. Two-way pressure independent water control valves shall be sized for a pressure drop of approximately 3 psi. Higher pressure drop shall be provided if allowed or directed by the A/E (during shop drawing review) where branch pressure to a controlled equipment is felt to be significantly more than the equipment pressure drop.
 - 2. Three-way water control valves shall be sized for a pressure drop of approximately 2.5 psi.
 - 3. Steam valves for equipment having condensate draining to near-atmospheric pressure shall be sized for a pressure drop of approximately 50% of the normal steam supply pressure.
 - 4. Valve body and actuator selection shall be sufficient to handle system pressure and shall close against the system differential pressures.
 - 5. Valve service rating shall be 125 psig. or greater.
 - 6. The shafts to which the actuators are coupled shall be square or hexagonal or round with one side flattened to insure tight coupling.
 - 7. Install valves in the orientation recommended, or stated as preferred, in manufacturer's literature.
- B. Provide valves with rotating control stems except where "lift and lay" valves are specifically identified. Use the following valves unless they are unsuited for a specific application:
 - 1. Use Belimo or Delta characterized ball valves with actuators for sizes ranging from 1/4" to 2" full port. Where valves are for open-close application only, the "characterized" feature shall not be provided, provide full port size.
 - 2. Zone valves: Valves shall be constructed with a cast brass body and stainless-steel balls. The valve shall provide for 100% shut-off and silent operation.

- C. Use butterfly valves when characterized ball valves do not provide necessary CV. Butterfly valves with disks attached to the stem with screws, bolts or rivets are not acceptable. Use Demco, Victaulic or approved equal. Butterfly Valves: 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
- D. Steam valves shall be Siemens 599 or approved equal.
- E. Hydronic system globe valves shall have the following characteristics:
1. NPS 2 (DN 50) and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with back-seating capacity repackable under pressure.
 2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 4. Sizing: 5-psig maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.
 - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
 - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
 5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- F. Steam system globe valves shall have the following characteristics:
1. NPS 2 (DN 50) and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with back-seating capacity repackable under pressure.
 2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 3. Internal Construction: Replaceable plugs and stainless-steel seats. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
 4. Sizing: For pressure drop based on the following services:
 - a. Two Position: 20 percent of inlet pressure.
 - b. Modulating 15-psig Steam: 80 percent of inlet steam pressure.
 - c. Modulating 16- to 50-psig Steam: 50 percent of inlet steam pressure.
 - d. Modulating More Than 50-psig Steam: As indicated.
 5. Flow Characteristics: Modified linear characteristics.
 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of operating (inlet) pressure.

- G. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
 - 1. Rating: Class 125 for service at 125 psig and 250-degree F operating conditions.
 - 2. Thermostatic Operator: Liquid filled remote sensor with integral adjustable dial.

2.19 DAMPERS

See Section 233300 - Air Duct Accessories.

2.20 Variable Frequency Drives (VFDs)

- A. VFDs for division 23 equipment shall be provided by the controls system subcontractor as per section 230915.
- B. Division 26 contractor shall install field mounted VFDs and provide power wiring to the VFDs and from the VFDs to their controlled motors.
- C. The controls system subcontractor shall provide control wiring for VFDs. The controls system subcontractor shall provide VFDs for packaged and custom air handling units to the respective manufacturers specified in Section(s) [237000, 237012] for installation and wiring at the factory. Division 26 contractor shall provide power to factory mounted VFDs once they are installed in the field.

2.21 ENCLOSURES

- A. All enclosures to be NEMA 1, unless otherwise required for intended service. All controls and instruments shall be logically assembled at one or more panels, have hinged doors and be marked with engraved melamine labels.
- B. All enclosures used as a mounting site for control devices shall also contain a documentation holder located on the inside of the door.
- C. All enclosures shall be provided with locks.
- D. Label each equipment panel furnished with 120 VAC power with power source label showing identification of power panel and breaker.

2.22 WIRING AND CONDUIT

- A. Install wiring and conduit in accordance with Division 26 requirements.
- B. Minimum wire size shall be based on the manufacturer's recommendations based on the specific application. Single conductor wire insulation shall be THHN. All wires shall be sized in accordance with the NEC for the load serviced. A single conductor shall not be used for more than one leg of an input or output device circuit (no "common" conductors) unless approved by Owner.
- C. All wiring shall be stranded. Exceptions will be made for wiring used in preassembled factory crimped cables, 20 g and smaller, where connectors provide support to the insulated cable jacket at the point of connection.
- D. All low voltage energy limited wiring (except 24 VAC power), installed in open tray or installed as open wiring, shall be in jacketed cables dedicated to individual devices.

- E. Junction box covers shall be labeled "DDC" or show the vendor logo.
- F. Splicing shall be minimized and shall be done only in accessible outlet, junction, or cabinet boxes that are clearly shown on the "as-built" record drawings. Splicing shall be made with 3M "Scotchloc" spring connectors with steel cap and PVC insulation, Thomas & Betts, or a crimp on butt-splice, or approved equal. When splicing is necessary, the insulation colors shall match, and the conductors shall be mechanically secured to each other so that no stress is applied to the splice. Splicing of long runs shall be accomplished by means of a fully insulated crimped barrel connector.
- G. Wire pulls by powered mechanical means will not be permitted. Conduit shall be cleaned of foreign material just before pulling the wire or cable. Lubricants shall be compounds specifically prepared for cable pulling and shall not contain petroleum or other products that will affect cable insulation.
- H. Wire that has scrapes, nicks, gouges, or crushed insulation shall not be used and shall be removed when present.
- I. Groups of conductors, where installed in cabinets and wire trays, shall be neatly grouped with wire ties or equal.
- J. All wiring contained in metal wireways shall be in wireways dedicated to low voltage service.
- K. Low voltage energy-limited wiring shall not be run in the same wireways with, or closely parallel to, high voltage or switched power wiring. Interposing relays shall be used for all switched power loads and shall be located so that the switched power conductors do not run in the same wireway as the interposing relay coil power or any other energy-limited low voltage conductors.
- L. All wire shall be new and brought on the jobsite in original packages bearing Underwriter's label and the date of manufacture.
- M. Aluminum wire is prohibited.
- N. No conduit shall be filled so that the maximum bundled cross-sectional dimension exceeds 40 % of conduit inside diameter. No raceway shall be filled to more than 40% and maximum fill for "wire mold" (surface raceway) shall be 20%.
- O. No wire run or circuit shall be longer than 80% of the maximum allowable length or power consumption for the wire size and application. No output circuit shall exceed 80% of the maximum load capacity specified by the manufacturer.
- P. Wiring and conduit shall comply with Division 26 specifications.
 - 1. The basic wiring method shall be in conduit unless otherwise permitted in this section.
 - 2. Where conduit direct connection is not possible, all permitted open wiring shall be plenum rated.
 - 3. Permitted open wiring is limited to the following applications:
 - a. Wiring from a zone airflow control unit to a nearby temperature sensor not to exceed 50 feet
 - b. Wiring from a zone airflow terminal control unit to a nearby water control valve not to exceed six feet
- Q. Wiring from any controller to a device which has otherwise been approved for installation and cannot accept conduit connection shall meet the following requirements:

1. Conduit shall be used to within 12 inches of the device.
 2. Install in wireway all trunk communication wiring between the operator station and the controllers, and between controllers. Open wiring is not otherwise permitted.
- R. Conduits shall be provided with appropriate bushings and end fittings to protect cabling from sharp conduit edges.
- S. Conduit size shall be $\frac{3}{4}$ -inch minimum for all wiring groups consisting of six or more conductors. NEC requirements shall apply as though conductors were used to their full current carrying and thermal capacity.
- T. Wireway runs shall be level, plumb, parallel or perpendicular to walls, pipes and sides of openings. Wireways shall follow the contours of the support surface. Passageways for access and servicing shall not be blocked.
- U. All wiring between global controllers and trunk, N2 and LAN cables longer than 300 feet shall be 100% backed up with spare conductors.
- V. All conductors that become bundled or pass from an enclosure shall be identified with typed or machine lettered labels, Briade or approved equal. Tag numbers shall agree with wire numbers assigned on wiring diagrams and the installation drawings.
- W. Wires shall be labeled with mechanically prepared labels at their connection point to each apparatus point of connection.
- X. UL/ULC Listed Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls and for final connection to equipment.
- Y. Open wiring, when permitted, shall be installed in compliance with WAC 296-46-725 with reference to NEC 336-15 and shall also be installed as follows:
1. All open wiring that penetrates through walls and crosses structural ceilings shall do so within 18 inches of the structural ceiling surface.
 2. Wiring shall be attached to vertical supports at attachment points prepared by a protective wrap of electrical tape around the support. This wrap shall create a surface free of sharp edges.
 3. Absolutely no wire is to be attached to pipe work or conduit of any kind.
 4. Wire ties, if used, shall be trimmed so as to reduce sharp edges.
 5. The vendor shall provide required cabling attachment points for control's use if the ceiling structure does not provide acceptable attachment points.

2.23 CONTROL RELAYS

- A. Panel relays shall be plug-in type with contacts rated at twice the amperage rating of circuit requirements: Minimum temperature range -25° C to $+70^{\circ}$ C. Enclosure: Clear dust cover and shock resistant, rated for minimum of 2.5 million mechanical operations and 100,000 electrical operations at full load.
- B. Remote/interposing relays shall be used for all remote switched loads.
1. They shall be housed in a NEMA-rated enclosure. Where two or more relays are mounted in the same enclosure, provide a hinged cover.
 2. Besides meeting panel relay requirements, relays shall have 24 VDC coils and form C dry contacts with a minimum rating of 5 amperes @ 240 VAC.

3. Relays controlling inductive loads shall be equipped with coil transient suppression devices to limit transients to 150% of rated coil voltage.

2.24 TRANSFORMERS

- A. 120V AC to 24V AC transformers shall be supplied to provide control voltage to the control system. The incoming 120V AC power shall be fused. Transformers shall be supplied with suitable mounting plates and mounted in separate electrical panel boxes with hinged covers adjacent to control system panels.

2.25 SPARE PARTS

- A. Replacement Materials: Provide one replacement for each unique controller, damper motor, valve motor, thermostat, relay, etc.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS.

- A. General: All work under this section shall be a subcontract by an authorized agent of the manufacturer.
- B. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Notations at Instruments: A typewritten notation shall be provided at each instrument stating its use; at thermostats, the proper setting. In finished spaces these notations shall be secured to the inside of the case; in other areas, shall be secured by adhesive to the duct or other adjacent surface and shellacked over. Instruments and equipment, whose use is self-evident, such as ordinary room thermostats, radiator valves, or similar unitary equipment valves, will not require such notations.
- D. Penetrations of Ducts: All penetrations shall be properly sealed to prevent leakage around the opening; shall include a stuffing box type of closure or similar approved method.
- E. Pipe Wells: Provide pipe wells for insertion of temperature sensors in water lines. Temperature sensing wells shall be of sufficient length to reach midway into pipe, with extension necks where installed or insulated piping. Wells shall be brass or stainless steel; installed in lines using tees or thread-o-lets.
- F. Insertion Thermostats: Provide for all duct and water temperature sensing; capillary connected if averaging bulb type; capillary or rod and tube type for other units; non-bleed; throttling range as required for service; on water circuits, separable socket type; remote readjusting type where specified, adjustable ratio, straight line action, adjustable limit stops.
- G. The freezestats used on fan shut-down control shall be wired to stop the fan in both the Auto and Hand positions of the HOA switch. Freezestats shall be overridden by the fire alarm controls.
- H. Wall mounted temperature sensors shall be mounted on electrical boxes, and all wire penetrations shall be sealed to prevent thermal convection.

- I. It is the responsibility of the controls vendor to ensure that all sensors are placed in the measurable flow path to accurately measure the sensed variable. As a minimum, water flow sensors shall be installed with a straight section of piping 10 diameters upstream and four diameters downstream.
- J. Sensors installed for outside air measurement and pressurization shall be located to optimize the accuracy of the measurement. Coordinate with Mechanical Consultant.
- K. Valve operators shall be installed directly above the controlled valve whenever possible (with the exception of steam control valves where actuator is rotated to about 30 degrees to avoid hot zone directly above valve) unless rotation is needed to permit maintenance access. However, in no case shall the operator be rotated to or beyond horizontal.
- L. Freezestats shall be installed with capillaries supported by non-metallic standoffs. No part of the capillary shall otherwise touch the coil or frame.
 - 1. Provide mounting support for the capillary at least every 36 inches and at the capillary end, within 6 inches.
 - 2. Freezestats shall be mounted to the upstream face of the first coil that they are designed to protect, usually the cooling coil.
 - 3. Locate reset head on outside of plenum wall.
 - 4. Install such that the temperature-sensing element is sloped continuously downward from the sensing head.
- M. Freezestats' capillary length shall provide one foot of capillary for each four-square feet of coil surface (by multiple freezestat units if necessary to meet this requirement). In all cases the coil face shall be completely crossed from corner to corner, with the freezestat control head mounted at the highest capillary point to maintain calibration.
- N. Dual Duct Terminal unit discharge temperature sensor shall be mounted a minimum of 36 inches downstream from the unit.
- O. All devices shall be mounted within enclosures. Cable trays and external cabinet surfaces shall not be used as mounting surfaces. Proof of run for both fans and pumps shall be by current sensing devices rather than differential pressure switches.
- P. All pressure indicating/measuring devices shall be installed with capped tee devices to permit attachment of test meters.
- Q. Controls Mounting: Controls shall be grouped by systems, areas, or other appropriate basis concealed in locking-type wall-mounted cabinets, with proper labeling as to functions and settings marked on the front thereof, located no more than 6'-0" above the floor unless specifically approved by Owner. Control cabinets shall not be installed on ductwork or plenum walls. Mount all relays, switches, contacts, etc., in common panels. Tag each instrument by use of approved labels corresponding to symbols used on control drawings.
- R. Location of Room Sensors: Where sensors are mounted at light switches, locate on centerline of the electrical outlet box, as directed. Sensors shall not be located above dimmer switches. Exact location of sensors shall be verified with final casework and furniture layouts.
- S. Verify location of thermostats, CO2 sensors and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches or 60 inches above the floor. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- T. Install guards on thermostats in the following locations:

1. Entrances.
 2. Public areas.
- U. Install automatic dampers according to Division 23, Section 233300, "Air Duct Accessories."
- V. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- W. Install labels and nameplates to identify control components according to Division 23, Section 220550, "Identification for HVAC Piping and Equipment."
- X. Install hydronic instrument wells, valves, and other accessories according to Division 23, 232113, Section "Hydronic Piping."
- Y. Install steam and condensate instrument wells, valves, and other accessories according to Division 23, Section 232312, "Steam and Condensate Heating Piping."
- Z. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

3.2 CONTROL SOFTWARE PROGRAMMING

- A. Control of equipment as described in the sequence of operations and shall include:
1. Time and holiday schedules
 2. Alarm limits and histories
 3. Summary of data for each zone
 4. Trend logs and historical data
 5. All setpoints
 6. Master menu
 7. Dynamic color graphic Interface
- B. The following Points Descriptions and Sequences of Operation shall be enhanced as necessary and included as part of the control drawings to expand and clarify information shown in the drawings.
1. Points information shall be displayed and organized by system in dynamic graphic form at the operator stations.
 2. The energy reduction software and miscellaneous functions shall manage all points.
 3. It shall be possible to "disconnect" any output or setpoint from the AUTOMATIC control logic and enter a MANUAL value or state from any Operator Station.
 4. It shall be possible to replace any input with a MANUAL value from any Operator Station.
 5. All control loop parameters for each loop shall be displayed on one display.
- C. Where a point or device is indicated on a drawing, it shall be provided even if not required in a sequence of operation (sequence). Where a point or device is required for a sequence, it shall be provided even if it is not shown on a diagram or plan.
- D. All setpoints indicated in the sequences are suggested initial setpoints. Actual setpoints shall be determined and programmed during system balancing and commissioning process. If actual setpoint determined during this process is substantially different from the initial suggested setpoint, request confirmation of acceptability from the A/E.
- E. All setpoints and values indicated in the sequences shall be adjustable with authorized access. Owner shall determine/confirm the appropriate access level during Owner training. It shall be possible to have multiple access levels with limited range of adjustability for each level.

- F. All sequences shall apply when the Operator (with proper access) allows automatic control via an Operators Station. It shall be possible to override to prevent automatic operation and take manual control of any system or equipment item. If automatic start-stop operation is not discussed in sequence for a particular device, then there shall be a manual "on-off" command feature at the Operators Station.
- G. Displays: Every control device indicated on the drawings or specifications and every point required in the sequences of operation shall have information displayed at the Operators Station(s). All information displayed shall have a simple and concise description of what the information is and means. Certain display requirements are indicated in the sequences. To avoid unnecessary duplication, other more typical display requirements are not indicated in every sequence but shall be provided for every device or point as follows:
1. Every device or equipment item that has a start-stop, open-closed, on-off or similar binary output from the BAS shall have an operational status display. Display shall include multiple pieces of information, as follows:
 - a. Current "on-off" command from EMCS
 - b. Current "on-off" condition as sensed by proof switch (where available).
 - c. Virtual "on-off" condition if a proof switch is not available, but other sensors can provide a reasonable verification of equipment operation. For example, such a reasonable verification may include using an analog pressure sensor downstream of a fan where a sensed value above a certain level could only occur if the fan was in operation.
 - d. Indication as to if control is in automatic mode (controlled per sequence) or in manual mode.
 2. Every device or equipment item that has a binary (open-closed contact) input to the BAS shall have an operational status display. Display shall include:
 3. Current condition.
 4. Every device or equipment item that has an analog control output from the BAS shall have an operational status display. Display shall include multiple pieces of information, as follows:
 - a. Current setpoint.
 - b. Commanded output (percent of maximum).
 - c. Display of the measured value at the controlling sensor or VFD.
 - d. Indication as to if control is in automatic mode (controlled per sequence) or in manual (override) mode.
 5. Every device or equipment item that has an analog input to the BAS shall have an operational status display. Display shall include:
 - a. Current measured condition.
 - b. Whether alarm feature is active.
 - c. Current setpoint for high and low alarm conditions.
 6. Unless indicated otherwise in the sequences, all stated values shall be assumed to use units of measurement displayed (at operator workstations) as follows:
 - a. Temperature in degree F.
 - b. Humidity in relative humidity (percent).
 - c. Air pressure (and differential pressure) in inches water column.
 - d. Water or steam pressure (and differential pressure) in PSIG.
 - e. Water flow rate in GPM.
 - f. Air flow rate in CFM.
 - g. Speed as percent of maximum RPM (when motor is driven at 60 hertz by VFD).

7. The following points shall be displayed using calculated values based upon commanded position unless exact values, as indicated by a feedback signal, are required by control strategy:
 - a. Fan speed (per cent of full speed)
 - b. Damper positions (per cent of full open)
 - c. Heating and cooling valve position (per cent of full open)
 - H. Trend Logs: Provide trend log programming and setup for individual points as requested by the Owner up to a maximum of three percent of all inputs provided on the project.
 - I. Alarms: Certain special alarm requirements are indicated in the sequences. To avoid unnecessary duplication, all necessary alarm requirements are not indicated in every sequence. In addition to the listed alarms, every point shall be equipped to (potentially) have the following alarms. Each alarm shall include specific text (on screen) describing the nature of the alarm, and the source of the alarm information (such as "current sensing relay", "differential pressure switch", etc.) Each point shall be capable (with only programming and setup required) to alarm as follows:
 1. Every device or equipment item that has a start-stop, open-closed, on-off or similar command from the BAS shall have an alarm to identify failure to operate as commanded. This alarm shall use available proof switches or other sensors that can be used as a "virtual proof". Provide suitable delays to accommodate equipment startup times, etc.
 2. Every device that has a binary (open-closed) input to the BAS that would normally be used as an alarm or service-requirement indicator (such as a differential pressure switch at a filter) shall provide suitable alarm annunciation.
 3. Every device or equipment item that has an analog control output from the BAS shall have an alarm to identify failure of system to maintain setpoint at the controlling sensor. Provide suitable delays to accommodate equipment startup times, etc. Establish reasonable high and low condition alarm trigger points to accommodate normal and reasonable variations in system output.
 4. Every VFD shall have an alarm contact monitored by the EMCS to acknowledge any faults. It shall also have an additional alarm contact monitored by the BAS to acknowledge if it is in the bypass mode.
 - J. Alarm Programming: Provide alarm programming and setup for all alarms specifically indicated in the sequences of operation, and at additional points as requested by the Owner up to a maximum of 20% of all inputs provided on the project. Assign operator high and low alarm limits according to design data or as Owner requests. It is assumed that Owner will want alarms to be set up for all filter switches and at all inputs indicated, but not addressed in the sequences.
 - K. Additional Control Requirements: Auxiliary Air Conditioning Units: Provide all control work required for all auxiliary air conditioning units. Include field wiring for any remote devices provided with each unit. Systems shall be controlled per manufacturer's recommendations and as follows: Provide DDC temperature sensor except where sensors are furnished with equipment.
- 3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION
- A. All electrical control wiring and terminations for the control system shall be provided by the controls subcontractor,
 - B. Install raceways, boxes, and cabinets according to Division 26, Section 260533, "Raceway and Boxes for Electrical Systems."

- C. Install building wire and cable according to Division 26, Section 260519, "Low-Voltage Electrical Power Conductors and Cables."
- D. Install signal and communication cable according to Division 27, Section 271500, "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- E. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- F. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 WORK BY OTHERS

- A. The mechanical subcontractor shall install all wells, pressure tapplings for flow sensors, etc., and shall set all control valves in place under the manufacturer's supervision. Pressure taps shall include service valves and calibration taps.
- B. The sheet metal subcontractor shall approve or correct the submitted schedule of required control damper quantities and sizes before dampers are ordered from the factory. Sheet metal Contractor shall receive dampers at the job site, set dampers in place under the manufacturer's supervision and provide an access door for each damper. Dampers shall be mounted square within the duct without twisting or distortion to insure proper damper operation. The damper shaft shall be extended at a location that provides space for the actuator.
- C. Patching and painting required for the control system installation will be accomplished by the General Contractor.
- D. All line voltage wiring required for control panels, alternators, motor starters are to be furnished and installed by the electrical subcontractor.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.

3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Pressure test control air piping at 30 psig or 1.5 times the operating pressure for 24 hours, with maximum 5-psig loss.
5. Test each point through its full operating range to verify that safety and operating control set points are as required.
6. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
7. Test each system for compliance with sequence of operation.
8. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.

- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 10. Provide diagnostic and test instruments for calibration and adjustment of system.
 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.
- 3.7 DEMONSTRATION AND ACCEPTANCE.
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01, Section 017900, "Demonstration and Training."
 - B. The building controls system subcontractor shall submit a proposed Acceptance Test Agreement for testing the system's functionality and the accuracy of all sensors and actuators.
 - C. The system installation shall be complete in all respects and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Engineer requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within 30 calendar days of the request. When the system has been deemed satisfactory in whole or in part by the Owner's representative, the system will be accepted for beneficial use which will start the warranty period for the commissioned portion.
- 3.8 COMMISSIONING
- A. Notify the Commissioning Agent one week prior to start-up of equipment.
 - B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.

- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END SECTION 23 09 00

SECTION 23 09 15
VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 RESPONSIBILITIES

- A. Variable frequency drives (VFD) for Division 23 equipment shall be provided by the controls system subcontractor specified in Section 230900. The controls system subcontractor shall provide control wiring for VFDs.
- B. Division 26 contractor shall install field mounted VFDs and provide power wiring to the VFDs and from the VFDs to their controlled motors.
- C. Contract Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county and state codes and ordinances.
 - A. Codes, Standards and References.
 - 1. IEEE 519, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 - 2. NFPA 70, National Electrical Code.
 - 3. UL 508, Industrial Control Equipment.
 - B. After factory assembly, test each VFD using a dynamometer to cycle from minimum to full load, including features and accessories. Include test report for each VFD in the Operation and Maintenance Manual.
 - C. Installer Qualifications: Installing contractor shall have successfully installed VFDs in at least 10 facilities. Installations shall be similar in configuration to this project.
 - D. Manufacturer shall maintain a service center or service representative within 50 miles of the project site. This center shall be capable of the following services:
 - 1. Factory coordinated start-up service.
 - 2. Emergency service calls, including replacement parts, within 24 hours.
 - 3. Service agreements.
 - 4. Training of customer personnel in operation and basic troubleshooting.
 - E. Provide all VFDs from a single VFD manufacturer. All VFDs shall have the same customer interface. The keypad and display shall be identical and interchangeable for all sizes of VFDs.

1.3 SUBMITTALS

- A. Product Data. Submit manufacturer's technical product data and maintenance data for each VFD.

- A. Shop Drawings. Submit control wiring diagram indicating factory and field installed wiring.
- B. Total harmonic voltage distortion and total harmonic current distortion. Provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5% at the point of common coupling as described in IEEE-519. The manufacturer shall submit calculated line distortion percentages in accordance with IEEE -519, based upon the total connected horsepower and source kilovolt-amperes of the utility and emergency power distribution system. Use electrical data (transformer KvA and impedance) from the electrical drawings.

1.4 WARRANTY

- A. Warrant VFD for 18 months from date of shipment. Warranty shall cover parts, labor, and travel time.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Danfoss VLT, ABB ACH550, Allen Bradley Powerflex 70. Other manufacturers will have to be preapproved and demonstrate that they meet all the requirements in this specification.

2.2 COMPONENTS AND REQUIREMENTS

- A. Description:
 - 1. General: Variable torque type.
 - 2. The VFD shall convert incoming fixed frequency three-phase AC power into an adjustable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Obtain input power voltage from the mechanical equipment schedules.
 - 3. Capable of starting, stopping, and driving an AC variable output from 0 to 60 Hz while maintaining a constant volts/hertz ratio.
 - 4. Sized as required by motors as indicated on the Drawings. Where motor full load amps are not shown, use NEC Table 430-150 for sizing.
- B. Construction:
 - 1. UL listed and labeled assembly including specified options.
 - 2. Separate terminal blocks for control and power wiring.
- C. Enclosure: UL listed and labeled. If indoor NEMA, outdoor shall be NEMA 3R surface mounted cabinet with hinged front door, top or bottom conduit entry.
- D. VFDs shall be UL listed for a short circuit current rating (SCCR) of 100kA and labeled with this rating.
- E. Components and Requirements:
 - 1. Electric disconnect lockable in OFF position with padlock.
 - 2. Defeatable door interlock to prevent door from being opened when operating handle is in ON position.

3. Internal control power circuit with transformer and protective fuses.
4. Full load output current rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 120% of rated torque for up to 0.5 seconds while starting.
5. The VFD shall have a dual 5% impedance DC link reactor on the positive and negative rails of the DC bus to minimize power line harmonics and protect the VFD from power line transients. The chokes shall be non-saturating. Swinging chokes that do not provide full harmonic filtering throughout the entire load range are not acceptable. VFDs with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor to provide acceptable harmonic performance at full load.
6. Limit motor noise as result of VFD to 3dB over line operation, measured at 3 feet from motor center line.
7. Adjustable acceleration and deceleration, commonly or separately, from 10 to 600 seconds.
8. Automatic adjustment of volts-to-hertz ratio to motor in proportion to load without changing speed.
9. Low frequency/low voltage starts with linear adjustable ramp up to pre-selected speed.
10. Status Indicators: Front-mounted graphical display to indicate the following conditions:
 - a. Power on and run status
 - b. Over voltage and over current.
 - c. Line fault and external fault.
11. Front panel operator interface with keypad and alphanumeric display for parameter setting and monitoring of:
 - a. Output frequency and RPM.
 - b. Output voltage and output current.
 - c. Faults (including memory of last 3 received faults).
 - d. DC bus voltage.
 - e. Calculated motor torque and calculated motor power (kW).
 - f. Parameters set via keypad without removing drive cover.
12. Front panel operator interface to read in English words without use of codes.
13. Manual speed setting on local control panel.
14. Hand-off-auto keys on the keypad. In HAND position, speed is adjusted by up and down keys. In OFF position, VFD cannot be started. In AUTO position, speed is controlled by remote signal and VFD can receive remote start command. Stop command in AUTO position can be either remote, integral, or from door mounted HOA switch.
15. Fused main disconnect, lockable in open position.
16. Start into spinning motor protection. Motor may be turning in either direction.
17. Input power dip ride-through and automatic restart after power interruption and after brownout. Automatic restart selectable via software programming.
18. Critical frequency range lockout, minimum of four critical frequency ranges.
19. Output filter designed for constant duty with VFD operating at full rated load to keep rate of rise for each pulse in output below 1,000 Volts per microsecond up to 160 feet cable length.
20. Output circuitry designed for constant duty with VFD operating at full rated load to prevent peak output voltage from reaching 1,000 Volts to ground at motor up to 160 feet of cable length for VFDs up to 60HP and up to 45 feet of cable length for VFDs 75HP and larger.
21. USB and/or RS-232 Port for local communications with laptop PC for VFD setup and programming with Windows-based software.
22. Real time clock with timed action functionality.
23. Six programmable digital inputs. Two terminals shall be programmable to act as either as digital outputs or additional digital inputs.
24. Two programmable relay outputs, Form C 240VAC, 2A, for remote indication of VFD status. Each relay shall have an adjustable on delay/off delay time.
25. Two programmable analog inputs that can be either direct-or-reverse acting.

- a. Each independently selectable to be used with either an analog voltage or current signal.
 - b. Each independently scalable from 0-10VDC and 4-20mA.
 - c. The VFD shall provide front panel meter displays programmable to show the value of each analog input signal for system set-up and troubleshooting.
26. One programmable, scalable analog current output (4-20mA) for indication of VFD status. This output shall be programmable to show the reference or feedback signal supplied to the VFD and for VFD output frequency, current and power. It shall be possible to scale the minimum and maximum values of this output.
27. VFD and motor shall be compatible with the distance between the drive and equipment. Provide any filtering as required.
- F. Optional Control and Monitoring Inputs and Outputs
1. Modules may include such items as:
 - a. Additional digital outputs, including relay outputs
 - b. Additional digital inputs
 - c. Additional analog outputs
 - d. Additional analog inputs, including Ni or Pt temperature sensor inputs
- G. Serial Communications:
2. It shall be possible through serial bus communications to read the status of all analog and digital inputs of the VFD.
 3. It shall be possible to command all digital and analog output through the serial communication bus.
 4. The VFD shall have an RS-485 port or USB port as standard. The standard protocols included in the VFD shall be Modbus RTU, Johnson Controls N2, and Siemens FLN.
 5. Optional protocols that must be available are BACnet MS/TP and LON.
 6. When BACnet is specified:
 - a. The VFD must be BTL listed as an Application Specific Controller (B-ASC).
 - b. If the VFD does not support Change-Of-Value (COV) capabilities or Read-Property-Multiple (RPM) BACnet properties, the Controls Contractor must provide separate, dedicated MS/TP networks for VFDs.
 7. Coordinate serial communication requirements with Controls Contractor.
- H. Fire Alarm System Interface:
8. Include dry contact override input to stop motor under any operating condition.
 9. Include dry contact override input to allow motor to operate at a speed predetermined by VFD programming.
 10. Include summary alarm dry contact for connection to fire alarm system indicating that VFD is not operable.
 11. Include a Fire Fighter Override Mode for "Run to destruction"
- 2.3 OPERATING CONDITIONS
- A. Displacement Power Factor: Minimum 95% at any speed.
 - B. Efficiency: Minimum 95% at rated load and frequency.
 - C. AC Line Frequency Variation: ± 2 Hz.

- D. AC Line Voltage Variation: $\pm 10\%$.
- E. Capacity: 100% continuous, 110% for 60 seconds.
- F. Input Power: Limited to 110% of motor load.
- G. Ambient Operating Temperature: 14-104°F.
- H. Relative Humidity: 0-95%, non-condensing.
- I. Elevation: Up to 3,300 feet without derating output power capability.

PART 3 - EXECUTION

3.1 INSPECTION AND INSTALLATION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until any unsatisfactory conditions are corrected. Do not install VFDs until building environment can be maintained within conditions required by manufacturer. Beginning work constitutes acceptance of conditions as satisfactory.
- B. Before and during installation, protect VFD from site contaminants.
- C. Coordinate required electrical and control installation work with other Divisions as required.
- D. Power Wiring: Comply with requirements in Division 26.
- E. Control Wiring: Comply with requirements in Section 230900.

3.2 START-UP SERVICES

- A. Manufacturer's authorized representative shall perform the following services:
 - 1. Verify installation connections and controls. Test continuity of each circuit.
 - 2. Adjust safety controls.
 - 3. Demonstrate satisfactory operation including line reactor during test run.
 - 4. Program VFD to automatically reapply power and drive motor to control set point upon resumption of power following power failure.
 - 5. Program VFD to attempt up to three automatic restarts within one hour after shutdown due to input power failure.
 - 6. Perform field assistance and additional technical support and devices to solve problems evidenced on site related to drive operation.
 - 7. Include field assistance and additional technical support and devices to solve problems evidenced on site related to VFD operation.
 - 8. Include start-up reports in the Operation and Maintenance Manual.

3.3 TRAINING

- A. Provide one two-hour training session to the owner's representative during normal business hours.

- B. Training to include:
1. Demonstrate operation of operator keypads for viewing data and setting parameters.
 2. Demonstrate operation in manual mode, including setting of specific speeds.
 3. Explain the drive parameters that might require operator adjustment.
 4. Demonstrate operation of door-mounted disconnect switches, if included in this project. Explain emergency operation.
 5. Describe troubleshooting techniques and warranty procedure.

3.4 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 09 15

SECTION 23 11 23
NATURAL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.
 - 6. Mechanical sleeve seals.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.
- C. Natural-Gas System Pressures within Buildings: One pressure. Pressure is less than 0.5 psig.
- D. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Dielectric fittings.
 - 6. Mechanical sleeve seals.
 - 7. Escutcheons.
- B. Delegated-Design Submittal: For natural-gas piping and equipment 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 seismic restraints.
 - 2. Design Calculations: Calculate requirements for selecting seismic restraints.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For pressure regulators to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping when factory applied, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - 1) Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
5. Protective Coating for Underground Piping: Factory-applied, three layer coating of epoxy, adhesive, and PE
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. Corrugated, Stainless-Steel Tubing (CSST): Comply with ANSI/IAS LC 1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 2 psig.
8. Note that if CSST is used, it shall be sized to meet or exceed the capacities of Schedule 40 metallic pipe per the sizing tables in the International Fuel Code. Sizes shown on the plans were obtained using Schedule 40 pipe. Contractor shall submit proposed sizing to Engineer for review prior to installation.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.

2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

- B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
1. CWP Rating: 125 psig.
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
- D. Manufacturers:
1. BrassCraft Manufacturing Company; a Masco company.
 2. Conbraco Industries, Inc.; Apollo Div.
 3. Lyall, R. W. & Company, Inc.
 4. McDonald, A. Y. Mfg. Co.
 5. Perfection Corporation; a subsidiary of American Meter Company.
 - a. Body: Bronze, complying with ASTM B 584.
 - b. Ball: Chrome-plated bronze.
 - c. Stem: Bronze; blowout proof.
 - d. Seats: Reinforced TFE; blowout proof.
 - e. Packing: Threaded-body packnut design with adjustable-stem packing.
 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 7. CWP Rating: 600 psig.
 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
1. Manufacturers:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
 2. Body: Bronze, complying with ASTM B 584.
 3. Plug: Bronze.
 4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Operator: Square head or lug type with tamperproof feature where indicated.
 6. Pressure Class: 125 psig.
 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

- A. General Requirements:
1. Single stage and suitable for natural gas.
 2. Steel jacket and corrosion-resistant components.
 3. Elevation compensator.

4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Meter Company.
 - b. Eclipse Combustion, Inc.
 - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - d. Invensys.
 - e. Maxitrol Company.
 - f. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

2.6 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - f. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
 3. Combination fitting of copper alloy and ferrous materials.
 4. Insulating materials suitable for natural gas.
 5. Combination fitting of copper alloy and ferrous materials with threaded, plain, or welded end connections that match piping system materials.
- B. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - d. Wilkins; Zurn Plumbing Products Group.
 2. Minimum Operating-Pressure Rating: 150 psig.
 3. Combination fitting of copper alloy and ferrous materials.
 4. Insulating materials suitable for natural gas.
 5. Combination fitting of copper alloy and ferrous materials with threaded, plain, or welded end connections that match piping system materials.
- C. Dielectric-Flange Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Central Plastics Company.
 - 1) Pipeline Seal and Insulator, Inc.
 2. Minimum Operating-Pressure Rating: 150 psig.
 3. Companion-flange assembly for field assembly.
 4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
 5. Insulating materials suitable for natural gas.
 6. Combination fitting of copper alloy and ferrous materials with threaded, plain, or welded end connections that match piping system materials.
- 2.7 SLEEVES
- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast- Iron Pipe Sleeves: Cast or fabricated "wall pipe", equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.8 MECHANICAL SLEEVE

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
 - 3. Pressure Plates: Stainless steel.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install fittings for changes in direction and branch connections.
- C. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

- D. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- E. Install pressure gage downstream from each service regulator.

3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install escutcheons at penetrations of interior walls, ceilings, and floors.
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped- steel type.
 - d. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - g. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - h. Piping in Equipment Rooms: One-piece, cast-brass type.

- i. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - j. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- L. Verify final equipment locations for roughing-in.
- M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- O. Extend relief vent connections for line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- P. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- Q. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 - 3. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- R. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- S. Connect branch piping from top or side of horizontal piping.
- T. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- U. Do not use natural-gas piping as grounding electrode.
- V. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- W. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.5 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing connector.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- B. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.8 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within
- E. 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- F. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 - 2. Steel pipe with malleable-iron fittings and threaded joints.

- B. Aboveground, distribution piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- 3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 2 PSIG
- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 - 2. Steel pipe with malleable-iron fittings and threaded joints.
 - B. Aboveground, distribution piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with steel welding fittings and welded joints.
- 3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE
- A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - B. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - C. Valves in branch piping for single appliance shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.

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SECTION 23 21 00

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. This section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Air-vent piping.
 - 3. Safety-valve-inlet and -outlet piping.
- B. Related Sections include the following: Division 23, Section 23 21 23, "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-Water Heating Piping: 150 psig at 200°F.
 - 2. Dual-Temperature Heating and Cooling Water Piping: 150 psig at 200°F.
 - 3. Blowdown-Drain Piping: 80 psig at 100 degrees F.
 - 4. Air-Vent Piping: 150 psig at 200°F.
 - 5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.4 SUBMITTALS

- A. Product Data: Submit for each type of the following: Plastic pipe and fittings with solvent cement.
- B. Submit product data for metal pipe and tubing, with specification, class or type, and schedule.
 - 1. Valves. Include material data, pressure/temperature ratings, flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air control devices.
 - 3. Chemical treatment.
 - 4. Hydronic specialties.
- C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

- D. Welding certificates.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
 - 3. Systems operating above 150 psi must comply with ASME B31.1 or B31.3
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.
- D. Coordinate inspection work with owner designated welding inspector.
- E. Piping shall have identification affixed at factory with proper ASTM identification. Piping specialties, including valves, shall have the manufacturer's trademark, name and/or model number and pressure rating, where applicable, affixed to permanently identify the manufacturer of product.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type K or L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. Wrought-Copper Fittings: ASME B16.22.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.
 - d. Stadler-Viega
 - e. Bronze Flanges and Flanged Fittings: ANSI/ASME B16.24.
 - 3. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
 - 4. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting.
 - 5. Copper or Bronze Pressure-Seal Fittings:

- a. Manufacturer: Subject to compliance with requirements, provide products manufactured by Stadler-Viega.
- b. Housing: Copper.
- c. O-Rings and Pipe Stops: EPDM.
- d. Tools: Manufacturer's special tools.
- e. Minimum 200-psig (1379-kPa) working-pressure rating at 250 degrees F (121 degree C.)

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53 Grade B seamless or ERW, Schedule 40, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- F. Wrought Steel Butt Weld Fittings: ANSI/ASME B16.9 with same wall thickness as connecting piping.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 1. Standardization: All mechanically coupled piping products shall be of one manufacturer
 2. Basis-of-Design size 2-1/2" to 24":
 - a. Anvil International, Inc.
 - b. Victaulic Company of America.
 3. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 4. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.
- C. CPVC Solvent Cement: ASTM F 493.
- D. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- E. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.
- F. PVC Solvent Cement: ASTM D 2564.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. Submit gasket compatibility data for glycol service.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company
 - b. IPEX Inc.
 - c. KBi
2. One-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end. Materials to match adjoining piping.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
 - d. NIBCO INC.
2. MSS SP-107, Plastic union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union. Materials to match adjoining piping.

2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Dielectric Fittings Two-inch and Smaller: Threaded dielectric union, ANSI/ASME B16.39.
- C. Dielectric Fittings 2-1/2-inch and Larger: Flanged union with dielectric gasket and bolt sleeves, ANSI/ASME B16.42.
- D. Insulating Material: Suitable for system fluid, pressure, and temperature.
- E. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company
 - b. Central Plastics Company
 - c. Hart Industries International, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division
 - f. <Insert manufacturer's name.>
 2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 degrees F.
- F. Dielectric Flanges:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company
 - b. Central Plastics Company
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

G. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company
 - d. Pipeline Seal and Insulator, Inc.
2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

2.7 VALVES

A. General Requirements For Valves:

1. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
2. Valve Sizes: Same as upstream piping unless otherwise indicated.
3. Valve Actuator Types:
 - a. Gear Actuator: For quarter-turn valves NPS 6 and larger.
 - b. Handwheel: For valves other than quarter-turn types.
 - c. Handlever: For quarter-turn valves NPS 4 and smaller.
 - d. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
4. Valves in Insulated Piping: With two-inch stem **extensions** and the following features:
 - a. Gate Valves: With rising stem.
 - b. Ball Valves: With extended operating handle of nonthermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - c. Butterfly Valves: With extended neck.
5. Valve-End Connections:
 - a. Flanged: With flanges according to ASME B16.1 for iron valves.
 - b. Grooved: With grooves according to AWWA C606.
 - c. Threaded: With threads according to ASME B1.20.1.
 - d. Valve Bypass and Drain Connections: MSS SP-45.

B. HVAC Water System Valves (Not Grooved-End)

1. General: Utilize the following valves for water-based systems, such as chilled water, condenser water and heating water.
2. Shut-Off Valves 2" and Smaller: Ball type, ASTM B-61, ASTM B-62. Bronze body shall be ASTM B584 Alloy C84400. Two-piece body style, threaded ends, full port, chrome plated bronze ball, Teflon seats, adjustable packing, lever handle, blowout proof stem, 150 wsp, 600 wog.
 - a. Manufacturer:

- 1) Apollo No. 77C
- 2) Crane 9303-B
- 3) Milwaukee BA-400
- 4) Nibco No. T-585-70
- 5) Watts No. B-6080
- 6) Red-White No. 5044F
- 7) OR

3. Shut-Off Valves 2" and Smaller: Ball type, ASTM B-61, ASTM B-62. Bronze body shall be ASTM B584 Alloy C84400. Two-piece body style, threaded ends, full port, ASTM 276 Type 316 stainless steel ball and stem, Teflon seats, adjustable packing, lever handle, blowout proof stem, 150 wsp, 600 wog.

a. Manufacturer:

- 1) Apollo No. 77C-140
- 2) Crane 9303-S
- 3) Nibco No. T-585-70-66

4. Shutoff Valves 2-1/2" through 12": Butterfly type, full lug, ductile iron body, 400 series stainless steel stem, aluminum bronze disc, EPDM liner and seals, upper and lower stem bearing, blowout proof stem, extended neck for minimum 2" insulation, manufacturer recommended for bi-directional dead end service at full rated pressure without a downstream flange, sizes 2-1/2" through 4" shall be lever operated and 200 psi cwp; 6" through 12" shall be gear operated and 200 psi cwp; 14" and larger shall be gear operated and 150 psi cwp.

a. Manufacturer:

- 1) Demco No. NEC-511
- 2) Keystone No. HS-2
- 3) Milwaukee No. CL Series
- 4) NIBCO No. LD-2000

5. Gate Valves 2" and Smaller: Bronze body, solid wedge disc, nonrising stem, screw-in bonnet, malleable iron hand wheel, threaded ends, 125 wsp, 200 wog.

a. Manufacturer: Milwaukee No. 105, NIBCO No. T-113, Stockham No. B-103.

6. Gate Valves 2-1/2" and Larger: Cast-iron body, bronze trim, OS & Y, bolted bonnet, flanged ends, 125 wsp, 200 wog.

a. Manufacturer: Milwaukee No. F2885-A, NIBCO No. F-617-0, Stockham No. G-623.

7. Globe Valves 2" and Smaller: Bronze body, teflon disc, integral seat, union bonnet, malleable iron handwheel, 150 wsp, 300 wog.

a. Manufacturer:

- 1) Crane 7TF
- 2) Hammond IB413T
- 3) Milwaukee No. 590T
- 4) NIBCO No. T-235-Y
- 5) Red-White No. 221
- 6) Stockham No. B-22

8. Globe Valves 2-1/2" and Larger: Cast iron body, bronze trim, bolted bonnet, screwed-in brass body seat ring, solid brass disc, bronze stem, flanged ends, 125 wsp, 200wog.

a. Manufacturer:

- 1) Crane 351
- 2) Hammond IR116

- 3) Milwaukee No. F2981A
- 4) NIBCO No. F-718-B
- 5) Red-White No. 400
- 6) Stockham No. G-512

9. Swing Check Valves 2" and Smaller: Bronze body, swing check, Teflon disc and seat, 125 wsp, 200 wog.

a. Manufacturer:

- 1) Hammond IB940
- 2) Milwaukee No. 509-T
- 3) NIBCO No. T-413-Y
- 4) Red-White No. 236T
- 5) Stockham No. B-320-T

10. Swing Check Valves 2-1/2" and Larger: Cast-iron body, horizontal swing check, bronze trim, with brass-faced disc, brass body seat ring, flanged pattern, 125 wsp, 200 wog.

a. Manufacturer:

- 1) Crane 373
- 2) Hammond IR1124
- 3) Milwaukee No. F2974-A
- 4) NIBCO No. F-918-B
- 5) Red-White No. 435
- 6) Stockham No. G-93

11. Pump Check Valves, Non-slam Type 2-1/2" and Larger: Wafer style, cast-iron body, bronze disc and seat, center guided, stainless steel spring and screws, 200 nonshock wog.

a. Manufacturer:

- 1) Hammond IR9253
- 2) Metraflex Style 700
- 3) Milwaukee No. 1400
- 4) NIBCO No. W-910-B

C. Grooved-End HVAC Water System Valves:

1. General: At Contractor's option, the following valves may also be used for 2-1/2" and larger water-based systems, such as chilled water, condenser water and heating water.
2. Ball Valves 2-1/2" to 3" Sizes: Ductile iron, two-piece body, grooved ends, standard port, chrome plated carbon steel ball and stem, TFE seats, lever handle, blow out proof stem, 740 psi cwp.

a. Manufacturer:

- 1) Anvil Gruvlok Series 7500
- 2) Nibco No. G-595-Y/G-590-Y
- 3) Victaulic Series 726

3. Butterfly Valves 2-1/2" to 4": Ductile iron body, EPDM synthetic rubber encapsulated ductile iron disc with integrally cast stem, lever operated with 10-position throttling plate, manufacturer recommended for bi-directional dead end service at full rated pressure without a downstream flange, 300 psi cwp.

a. Manufacturer:

- 1) Anvil Gruvlok Series 7700
- 2) Nibco No. GD-4765-3

3) Victaulic Vic®-300

4. Butterfly Valves 6" through 12": Ductile iron body, EPDM synthetic rubber encapsulated ductile iron disc with integrally cast stem, gear operated, manufacturer recommended for bi-directional dead end service at full rated pressure without a downstream flange, 300 psi cwp.

a. Manufacturer:

- 1) Anvil Gruvlok Series 7700
- 2) Nibco No. GD-4765-5
- 3) Victaulic Vic®-300

5. Check Valves 2-1/2" and Larger: Ductile iron body, horizontal or vertical spring-assisted check, stainless steel spring and shaft, grooved pattern, 300 psi cwp.

a. Manufacturer:

- 1) Anvil Gruvlok Series 7800
- 2) Victaulic Series 716

6. Pump Check Valves 2-1/2" and Larger: Ductile iron body, horizontal or vertical spring-assisted check, stainless steel spring and shaft, grooved pattern 300 psi cwp.

a. Manufacturer:

- 1) Anvil Gruvlok Series 7800
- 2) Victaulic Series 716

2.8 SPECIALTY VALVES AND ACCESSORIES

A. Automatic Balancing Hose Kits:

1. Furnish and install automatic balancing hose kits at each terminal unit hot water coil. Each kit shall include automatic flow control valve, two flexible hoses (insulated), two ball valves and accessories.
 - a. Manufacturer: Griswold CPP-2Y series with 18 inches of insulated hoses, Nexus, or Griswold.
 - b. Unless indicated otherwise, the minimum differential operating pressure shall be two psig.
2. Each hose kit shall be equipped with a two-way modulating control valve, complete with DDC actuator (furnished by the Section 230900 subcontractor), and mounted by the hose kit manufacturer. Special care shall be taken to ensure the finished assembly is protected against damage in shipping.
3. The flow control cartridge shall automatically control flow rates within five percent accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Three operating pressure ranges shall be available.
 - a. Flow control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.
 - b. Dual pressure/temperature test valves for verifying the pressure differential across the cartridge and system shall be included.
 - c. The manufacturer shall be able to provide certified independent laboratory tests verifying the accuracy of performance.
4. Supply and Return Hoses: All hoses shall be equipped with swivel-end connections at terminal unit. All end connections shall be crimped to meet stated pressure ratings. Serrated or slip fit connections are not acceptable.
 - a. Hose material shall be stainless steel braided over a synthetic polymer liner.

- b. Hoses shall meet or exceed ASTM D380-83 standard and withstand working pressures of 375 psi (1/2"), 300 psi (3/4"), 225 psi (1"), 200 psi (1 1/4") and 175 psi (1 1/2") at 200 degrees F.
 5. Isolation Valves: Valves shall be bronze body with level handle and rated for 600 psi w.p. Valves shall be full-ported type.
 6. Strainer: Strainer shall be Y-type, bronze body with brass cap, 300 psi w.p. Strainer screen shall be a 20 mesh stainless steel, easily accessible for cleaning. Strainer shall have blowdown tapping with drain valve with threaded cap. Strainers shall have identification tags.
- B. Combination Balancing/Shut-Off Valves:
 1. Provide balancing valves at coils, at circulating pumps and elsewhere as shown. Manufacturer: Nibco 1710, Armstrong "CBV" Circuit Balancing Valves, Bell & Gossett "Circuit Setter Plus" or Tour-Anderson Model STAD/STAS and STAF/STAG.
 2. Meter: Balancing valve manufacturer shall provide one portable meter for reading differential pressure in feet head. Each meter connection shall have positive shutoff valves. Meter shall have liquid-filled pressure gauge.
 3. Valves shall be globe body, flanged pattern and all metal parts of nonferrous, pressure die-cast, flow measurement; shall provide four functions:
 - a. Precise flow measurement
 - b. Precision flow balancing
 - c. Positive shut-off with no-drip seat and Teflon disc
 - d. Drain connection with protective cap.
 4. Valves shall have four 360-degree adjustment turns of handwheel for maximum Vernier-type setting with "Hidden Memory" feature to program the valve with precision tamperproof balancing setting.
- C. Balance Valves (Larger pipe sizes, balancing only):
 1. Valves shall be globe body, flanged pattern and all metal parts of nonferrous, pressure die-cast, nonporous copper alloy. Valves shall be capable of installation in any direction without affecting flow measurement; shall provide four functions:
 - a. Precise flow measurement.
 - b. Precision flow balancing.
 - c. Positive shut-off with no-drip seat and Teflon disc, and
 - d. Drain connection with protective cap.
 2. Valves shall have four 360°-adjustment turns of handwheel for maximum Vernier-Type setting with "Hidden Memory" feature to program the valve with precision tamperproof balancing setting.
 3. Provide hand-wheel protective cover to prevent accumulation of dirt and over-painting during construction.
 4. Manufacturer: Armstrong "CBV" Circuit Balancing Valves, Tour-Andersson Model STAD/STAS and STAF/STAG or Mepco MBVS.
- D. Drain Valves 1/2" to 3/4" Sizes: Bronze ball valve, two-piece body, standard port, chrome plated brass ball, RPTFE seats, lever handle, blow out proof stem, threaded or soldered with hose end, cap and chain, 150 psi wsp, 600 psi wog. Manufacturer: Milwaukee No. BA-100H or BA-150H.
- E. Bronze, Calibrated-Orifice, Balancing Valves:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

- a. Armstrong Pumps, Inc
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls
 - f. Taco
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Plug: Resin.
 5. Seat: PTFE.
 6. End Connections: Threaded or socket.
 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 8. Handle Style: Lever, with memory stop to retain set position.
 9. CWP Rating: Minimum 125 psig.
 10. Maximum Operating Temperature: 250 degrees F.
- F. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls
 - f. Taco
 - g. Tour & Andersson; available through Victaulic Company of America
 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 3. Ball: Brass or stainless steel.
 4. Stem Seals: EPDM O-rings.
 5. Disc: Glass and carbon-filled PTFE.
 6. Seat: PTFE.
 7. End Connections: Flanged or grooved.
 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 9. Handle Style: Lever, with memory stop to retain set position.
 10. CWP Rating: Minimum 125 psig.
 11. Maximum Operating Temperature: 250 degrees F.
- G. Diaphragm-Operated, Pressure-Reducing Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bell & Gossett B7-12 where adjustable range is 10 - 25 psig and Model 7 where adjustable range is 25 - 60 psig > or a comparable product by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - g. <Insert manufacturer's name.>
 2. Body: Bronze or brass.
 3. Disc: Glass and carbon-filled PTFE.
 4. Seat: Brass.
 5. Stem Seals: EPDM O-rings.
 6. Diaphragm: EPT.

7. Low inlet-pressure check valve.
8. Inlet Strainer: <Insert materials>, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Diaphragm-Operated Safety Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: <Insert materials>, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

I. Automatic Flow-Control Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - a. Flow Design Inc.
 - b. Griswold Controls
 - c. Nexus
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Corrosion resistant, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus five percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 degrees F

2.9 AIR CONTROL DEVICES

A. Manual Air Vents: Compression-type, screwdriver-operated air cocks shall be furnished and installed where shown and where required for venting. Cocks shall be 1/4" in size and shall be all bronze construction.

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.

4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/8.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 225 degrees F.
 8. Manual Air Vents Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries
 - d. Taco
- B. Automatic Air Vents (High Pressure): Single lever float type, 250 psi, 300°F cast iron body, 1/2" or 3/4" pipe connection as indicated. Float and internal mechanisms shall be stainless steel. Manufacturer: Hoffman No. 792, Armstrong No. 21 or approved Taco.
- C. Automatic Air Vents (Low-Pressure): Built-in serviceable check valve, all construction either brass or stainless steel.
1. Body: Bronze or cast iron.
 2. Internal Parts: Nonferrous.
 3. Operator: Noncorrosive metal float.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/4.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 240 degrees F.
 8. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hoffman No. 79 Low Pressure
 - b. Approved Taco, Amtrol, Bell & Gossett

2.10 PRESSURE AND TEMPERATURE TEST STATIONS

- A. Test Plugs: Provide 1/2" size, pressure and temperature type fitting constructed of solid brass with two valve cores of Nordel, suitable for 275°F at 500 psi. Each fitting shall include cap with gasket. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Peterson Equipment Co., "Pete's Plugs" or approved Sisco.
 2. Test Plugs in Insulated Piping: Pete's Plug "XL" Series or approved Sisco or Flow Design.
- B. Test Kit: Provide test kit consisting of 0–100 psi, 0–230 feet of water pressure gauge with gauge adapter attached, a 25–125°F pocket testing thermometer, a 0–220°F pocket testing thermometer and gauge adapter.

2.11 HYDRONIC PIPING SPECIALTIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Mueller Steam Company
 2. Armstrong Pump
 3. Watts
 4. Metraflex
 5. Armstrong International, Inc.
 6. Hoffman Specialty; Division of ITT Industries

7. Spence Engineering Company, Inc.
 8. Spirax Sarco, Inc.
 9. Bell & Gossett
 10. Taco
- B. Flexible connectors are specified in Division 23, Section 230548, "Vibration and Seismic Controls for HVAC."
- C. Expansion fittings are specified in Division 23, Section 230500, "Common Work Results for HVAC."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:
1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed pressure-seal joints.
 2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered, brazed joints.
 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Air-Vent Piping:
1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.
- D. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

- A. Install ball or butterfly type shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- C. Install check valves at each pump discharge and elsewhere as required to control flow direction.

- D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.
- E. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings. The drawings do not show all required fittings and offsets that may be necessary to connect pipes to equipment and to coordinate with other trades. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected.
- B. Install components furnished under other sections, such as: Control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls and column lines. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Space piping, including insulation, to provide one-inch minimum clearance between adjacent piping and other surfaces.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- N. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded hose adapter with cap, at low points in piping system mains and elsewhere as required for system drainage. Drains are generally not shown on the drawings.
 - 1. Where piping is located in heated space, provide drain valves at all low points where more than three gallons of water could be trapped.

2. Where piping is located in unheated space, including insulated piping with heat tracing, provide drain valves at all low points where any water could be trapped. In general, piping should be arranged to minimize the need for drain valves.
 3. Where drain valves are indicated on the drawings, extend piping as noted.
- O. Provide manual air vents at all high points in the piping systems where air might accumulate. Manual air vents are generally not shown on the drawings. Air vent valves shall be located in an accessible location and shall be positioned with discharge down such that a container can be held under the valve to receive liquid discharge. Provide tubing (same size as vent valve) from the top of the pipe to be vented to the accessible vent valve.
- P. Provide automatic air vents where indicated on the drawings. Discharge from automatic air vents shall be field-piped to the nearest floor drain with a one inch air gap.
- Q. Glycol systems: In glycol systems, pipe drain and vent valves (that are located in the same mechanical room) back to glycol mix tank, or glycol catch tank, do not discharge glycol to floors, floor drains or to outside.
- R. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- S. Locate and orient valves to permit proper operation and access for maintenance. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- T. Install unions or flanges in piping adjacent to valves, at final connections of equipment, and elsewhere as indicated. Offset equipment connections and carefully locate unions and flanges to allow for equipment removal and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with three-elbow swing joints or as noted on the drawings.
- U. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Strainers shall be installed line size, which shall mean the size of the inlet pipe shown on the drawings, not the reduced size serving the valve or equipment. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- V. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23, Section 230500, "Common Work Results for HVAC."
- W. Identify piping as specified in Division 23, Section 23 05 50, "Identification for Piping and Equipment."
- X. Test plugs in insulated piping shall have stem length as determined by insulation thickness.
- Y. Tee water piping runouts or branches into the side of mains or other branches. Where possible, do not use bull-head tees, which are two lines flowing into opposite ends of a tee and exiting out the common side.
- Z. Dielectric fittings shall be used at piping connections between copper and dissimilar metals at equipment or piping to protect from galvanic corrosion. Where dissimilar piping materials are separated by dielectric fittings the separation shall include isolation of pipe hangers by insulation, plastic coated hangers or support from a nonconductive structure.

3.4 HANGERS AND SUPPORTS

- A. Seismic restraints are specified in Division 23, Section 230540, "Vibration and Seismic Controls for HVAC."
- B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, seven feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, seven feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, nine feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 8. NPS 6 (DN 150): Maximum span, 17 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).
 9. NPS 8 (DN 200): Maximum span, 19 feet (5.8 m); minimum rod size, 5/8 inch (16 mm).
 10. NPS 10 (DN 250): Maximum span, 20 feet (6.1 m); minimum rod size, 3/4 inch (19 mm).
 11. NPS 12 (DN 300): Maximum span, 23 feet (7 m); minimum rod size, 7/8 inch (22 mm).
 12. NPS 14 (DN 350): Maximum span, 25 feet (7.6 m); minimum rod size, one inch (25 mm).
 13. NPS 16 (DN 400): Maximum span, 27 feet (8.2 m); minimum rod size, one inch (25 mm).
 14. NPS 18 (DN 450): Maximum span, 28 feet (8.5 m); minimum rod size, 1-1/4 inches (32 mm).
 15. NPS 20 (DN 500): Maximum span, 30 feet (9.1 m); minimum rod size, 1-1/4 inches (32 mm).
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, five feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, six feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, eight feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, eight feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, nine feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. 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 unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 - 3. Make up joint so only three threads show.
- G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Tighten flange bolts in accordance with gasket manufacturer's recommendations. Use full face gaskets and flat face flanges when connecting to equipment or valves with cast iron flat face flanges.
- I. Pressure-Sealed Joint: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- J. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- K. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

- L. Flexible Connectors: The piping gap shall be equal to the length of the expansion joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000 psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the expansion joint rating without them. All flexible connectors shall be installed on the equipment side of the shut off valves.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a two percent upward slope toward tank.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23, Section 23 05 19, "Meters and Gages for HVAC Piping."

3.8 SYSTEM CLEANING

- A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- C. Fill systems indicated to have antifreeze or glycol solutions with the following concentrations indicated on drawings.
- D. Preparation of Piping Systems:
 - 1. System shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system. Record capacity and include in Operation and Maintenance manuals.
 - 2. Make temporary piping connections; furnish temporary pumps, and temporary bypass filter as required to properly accomplish all cleaning operations.
 - 3. Place all manual and control valves serving coil banks and terminal control units in open position during cleaning so that circulation through the mains and runouts is obtained during cleaning.
- E. Piping System Cleaning Sequence: The services of a chemical treatment specialist shall be used for procedure and chemical selection.
 - 1. Qualified Contractors: Ashland Specialty Chemical, Garratt Callahan and the Nalco Company.

- a. Company shall only utilize qualified personnel active in the field of water treatment who are factory trained or authorized.
 - b. A single water treatment company for undivided responsibility shall perform startup, system check, water samples, analysis, cleaning, flushing, and testing.
2. Initial Flush, All Systems:
- a. Completely fill the system with fresh water and circulate (1st filling).
 - b. Initial flushing shall be sufficient to remove all contaminants such as cuttings, filings, loose rust & scale, welding and soldering residue and debris.
 - c. Drain the entire system, including dead legs, and refill with fresh water (2nd filling).
3. Closed Systems:
- a. Add the recommended dosage of cleaning solution to the system, circulate and bring up to the recommended temperature.
 - b. Test solution for proper concentration and document results.
 - c. Circulate the solution for the time recommended by the manufacturer (4 hours minimum and not to exceed the manufacturer's maximum limit).
 - d. Partially close and reopen all manual valves several times.
 - e. Operate all automatic valves through several cycles.
 - f. Completely drain the entire system.
 - g. Fresh Water Flush: Refill the system with fresh water (3rd filling). Then, with circulation pump running:
 - 1) Open one or more drains as far downstream from the fill point as is possible. Be sure the makeup is sufficient to keep up with the drain so as to maintain a full system.
 - 2) Partially close and reopen all manual valves several times.
 - 3) Blowdown all strainer, dead legs and low points in the system.
 - 4) Operate all automatic valves through several cycles.
 - 5) Continue to flush the system in this manner until the drain water is of the same clarity as the makeup water and testing reveals no further traces of cleaning solution (minimum one hour). Document the results.
 - h. Following the fresh water flush, drain the entire system:
 - 1) Clean all strainers.
 - 2) Remove all startup strainers.
 - 3) Drain all dead legs.
 - i. Fill System (Non-Glycol Systems): Within two hours of draining the system refill with fresh water and immediately start chemical treatment program. Chemical treatment must start within two hours of filling the system with water.
 - j. Fill System (Glycol Systems):
 - 1) Fill system with specified glycol, water and chemicals.
 - 2) Glycol solution MUST BE ADDED WITHIN TWO HOURS after final draining of the system. Confirm type of glycol to be added with owner prior to doing so.
 - 3) The cleaning firm shall, upon completion of filling system with glycol solution, tag each system so that tag is plainly visible as follows: "CAUTION THIS SYSTEM HAS BEEN "CHARGED" WITH GLYCOL. DO NOT DILUTE SYSTEM WITH WATER OR DRAIN SYSTEM WITHOUT AUTHORIZATION."

3.9 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Provide temporary valving or cap piping at connections to existing systems as required to confine testing to the new piping systems.
 5. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 6. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks. System must be proven to hold pressure for two hours.
 7. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.
- 3.10 COMMISSIONING
- A. Notify the Commissioning Agent one week prior to start up of equipment.
 - B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
 - C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

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SECTION 23 21 23

HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Separately coupled, vertical, in-line centrifugal pumps.

1.3 DEFINITIONS

- A. Buna-N: Nitrile rubber.
- B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.
- D. Submittals shall be approved prior to shipping from factory.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GENERAL

- A. Motors shall be matched to pump for non-overloading service at the design impeller diameter and full speed in variable speed applications.
- B. Motor size shall be as scheduled.

2.3 SEPARATELY COUPLED, VERTICAL, IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturers:
1. Armstrong Pumps Inc.
 2. Aurora Pump; Division of Pentair Pump Group.
 3. Bell & Gossett; Div. of ITT Industries.
 4. Burks Pumps; Div. of Crane Pumps & Systems.
 5. Patterson Pump Co.; a Subsidiary of The Gorman-Rupp Co.
 6. Peerless Pump; a Member of the Sterling Fluid Systems Group.
 7. Taco, Inc.
- B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 200 deg F.
- C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and flanged connections.
 2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance. Contractor shall provide pump impellor to supplier for re-trimming or replacement for system balancing.
 3. Pump Shaft: Stainless steel.
 4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and [Buna-N] [EPT] secondary seal bellows and gasket. Include water slinger on shaft between motor and seal. Provide ni-resist seal ring for 225 deg F operation, tungsten carbide seal ring for 225 deg F operation.
 - 5.
 6. Pump Bearings: Permanently lubricated ball bearings.
 7. Each pump shall be guaranteed to circulate not less than the specified quantity of water against the specified circulating head when operating continuously without overheating the motor or bearings, etc. and without producing noise, audible anywhere in the building, outside of the space in which the pumps are installed. Quiet operation is mandatory.
- D. Shaft Coupling: Axially split spacer coupling or molded rubber insert and interlocking spider type
- E. Motor: Single speed, with ball bearings, unless otherwise indicated; rigidly mounted to pump casing with lifting eye and supporting lugs in motor enclosure. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Comply with applicable standard HI 1.4 or HI 2.4.
- B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
- D. Install continuous-thread hanger rods and [elastomeric hangers] [spring hangers] [spring hangers with vertical-limit stop] of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- E. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 21 Section "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment." Hanger and support materials are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment/Hangers and Supports for HVAC Piping and Equipment."
- F. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
 - 1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
 - 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.
- G. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.
- H. Vibration-isolated Pumps: Bases are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Contractor shall furnish pump manufacturer's template for setting pump to inertia base manufacturer prior to submittal phase of project. Install with flexible connectors.
- I. Pipe-supported Pumps: Install pumps in accordance with manufacturer's recommendations and use pipe hangers or other supports at proper intervals to provide complete piping support near the pump. Both suction and discharge piping shall be independently supported and properly aligned so that no strain is transmitted to the pump when flange bolts are tightened.
- J. Balancing: After system balancing re-trim impellor or replace if required to optimize balance of system and reduce operating horse-power.

3.3 INSTALLATION OF PUMP SUCTION DIFFUSERS

- A. Following piping system cleaning and prior to balancing, remove start-up strainer.
- B. Adjust support foot or base support boss to eliminate pipe strain at suction diffuser connection to pump.

3.4 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation and HI 2.1-2.5, "Vertical Pumps for Nomenclature, Definitions, Application and Operation."
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts and verify pump alignment.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install non-slam type spring check valve and shut-off valve on discharge side of pumps.
- F. Install suction diffuser and shutoff valve on suction side of pumps on pumps with 3" and larger suction connection. Install shutoff valve on discharge of all pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.
- I. Install check valve and gate or ball valve on each condensate pump unit discharge.
- J. Install electrical connections for power, controls, and devices.
- K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.6 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 21 23

SECTION 23 31 00

METAL DUCTS AND CASINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg and metal casings. Metal ducts include the following:
 - 1. Rectangular ducts and fittings.
 - 2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.
 - 3. Double-wall, round, and flat-oval spiral-seam ducts and formed fittings.
 - 4. Duct liner.
 - 5. Turning vanes.
- B. Related Sections include the following:
 - 1. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset FRP ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, and flexible ducts.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. NUSIG: National Uniform Seismic Installation Guidelines.

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 SUBMITTALS

- A. Submit shop standard for ductwork construction utilized on this project. Include proposed duct gage, reinforcement interval, seam and joint construction for all sizes and pressure classes of rectangular, round, and oval ductwork. Submit construction standard for all plenums and fittings.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports, AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members, and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. Duct Protection, Cleaning, and Cleanliness Testing: Comply with requirements in Part 3 of this specification for protection, cleaning, and cleanliness testing of ductwork.
- D. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 General requirements –ductwork and Plenums

- A. Construction: Primary air duct construction, fittings, reinforcements, pressure and seal classifications and metal gauges shall conform to SMACNA HVAC/DCS, 2005 Edition including Addendum No. 1, 2005 SMACNA Duct Construction Standards and NFPA90A unless noted otherwise.
- B. Ducts and accessories shall not pulsate or vibrate when in operation.
- C. Test Ports: Provide instrument test holes with screw cap and gasket. Instrument test holes shall be attached to ducts and plenums with bolts. Seal around bolt head with duct sealant. Provide gasket to fit duct shape (rectangular or round) as needed. Provide all such test holes in ducts with instrument adapter as required for static pressure readings; exact location to be coordinated with air balancing contractor.
 - 1. Available Manufacturer: Ventfabrics No. 699
- D. Stuffing Boxes: Provide airtight stuffing boxes at all penetrations for instrumentation, such as sensors, thermostats, thermometers, pipes, etc.; use rubber grommets or U-channel rubber extrusions to create airtight seal.
 - 1. Available Manufacturer: "Rubbercraft".

- E. At connections to building construction, use steel angles fastened to the sheet metal by sheet metal screws, attached using anchor bolts embedded in the wall or slab, with sealant under the angle, angles 2"x2"x3/16" minimum.

2.3 SHEETMETAL DUCTWORK

- A. General: All ductwork shall be of sheet metal construction.
- B. Pressure and Seal Classification: Unless otherwise indicated, construct ducts according to the following:
 - 1. Supply ducts from outlet of air handlers and fans to terminal units: +4-in wg OR +6-in wg. Seal Class A.
 - 2. Supply ducts downstream of terminal units: +1/2-in wg OR +1-in wg OR +2-in wg Seal Class A.
 - 3. Return ducts: Negative 2-in wg, except ductwork from last volume damper to grille may be negative 1-in wg. Seal class A.
 - 4. Exhaust ducts: Negative 1-in wg OR negative 2-in wg. Seal Class A.
 - 5. Exhaust ducts serving isolation rooms: Negative 2-in wg. Seal Class A.
 - 6. Any ductwork upstream of any fire, smoke or combination fire/smoke damper conveying more than half of the total terminal airflow: +4-in wg. Seal Class A.
- C. Material schedule:
 - 1. All ducts shall be galvanized steel unless otherwise specified.
 - 2. Shower exhaust duct shall be made of aluminum to the first main connection.
- D. Galvanized Steel: Steel sheets, G-60 zinc-coated (galvanized) or zinc-iron alloy coated (galvannealed) by the hot dip process, conforming ASTM A653 unless noted otherwise.
- E. Aluminum: Type 3003-H14. Comply with requirements of ASTM B209.
 - 1. Rectangular Ductwork: Aluminum ductwork shall comply with the requirements of low pressure galvanized steel ductwork. Thickness adjustments of aluminum, including dimension adjustments and reinforcements needed to meet the construction requirement thickness of steel ducts, shall comply with SMACNA 2005 HVAC/DCS, Article 1.12.1, "Conversion of Steel Tables to Aluminum".
 - 2. Round Ductwork: Construction of aluminum duct and fittings shall otherwise correspond in the same relationship as for steel duct. Conform to SMACNA 2005 HVAC/DCS, Table 3-3, "Aluminum Round Duct Gage Schedule." Aluminum fasteners shall be used. Structural members shall be alloy 6061-T6 or galvanized steel as related in SMACNA Table 1-16 for rectangular duct. Hangers in contact with the duct shall be galvanized steel or aluminum.
- F. Stainless Steel: Comply with ASTM A 480/A 480M, Type 304 OR 316L, cold rolled, annealed, sheet.
- G. Flat oval ductwork is not permitted on exhaust or return systems.
- H. Pressure classes refer to both positive and negative ducts in absolute numbers unless noted otherwise.

- I. Round or Oval Elbow Construction: Round or oval segmented or mitered elbows shall be minimum 3-gore for 45°, 4-gore for 60°, and 5-gore for 90°. Adjustable round elbows are not permitted.
- J. Bellmouth transitions shall be used on connections to air handling units and plenums.
- K. Rectangular Elbows shall be radius or short radius with vanes, type RE 1 and RE 3 in the SMACNA manual. Mitered elbows with turning vanes and other types shall not be used, use short radius elbows with vanes where space is limited. Construct vanes per pages 4.5 and 4.6 (Figures 4-3 and 4-4) of the SMACNA manual.
- L. Turning vanes for rectangular elbows:
 - 1. Turning vanes shall be welded to runners at velocities exceeding 2,500 fpm.
 - 2. All sheet metal duct pressure classes and velocities: Airfoil Turning Vane is acceptable. Non-adjustable, double wall 26-gauge hot dipped galvanized steel, true airfoil type air turning vanes at square duct elbows. Factory runner, 24-gauge, with vanes 2.4" o.c. Available Manufacturer: "Aero Dyne Company", Model HEP.
 - 3. 2" wg. Pressure Class ducts or lower with velocities at or below 1500 fpm: 2" single width vanes, spaced 1.5" o.c. may be used when spanned lengths are 36" or less. Non-adjustable, single wall 24-gauge vane per SMACNA Fig. 4-3 & 4-4. Rail shall be 24-gauge. Available Manufacturer: "Duro Dyne", "Ductmate" Monorail.
 - 4. 3" wg. Pressure Class or higher ducts at any velocity and where duct velocities in any pressure class exceed 1500 fpm: 2" double width vanes, spaced 2.125" o.c. shall be used when spanned lengths are 48" or less. This vane is acceptable at lower pressure classes and velocities. Non-adjustable, double wall 26-gauge vane per SMACNA Fig. 4-3 & 4-4. The 22-gauge vane runner shall be of the tabbed style and shall have bent, or winged tabs. Straight tabs are not permitted. Available Manufacturer: "C.L. Ward & Family Inc." Turning Vane and Speedy Rail, "Ductmate" Turning Vane and PRORail.
 - 5. 3" wg. Pressure Class or higher ducts at any velocity and where duct velocities in any pressure class exceed 1500 fpm: 4.5" double width vanes, spaced 3.25" o.c. may be used when spanned lengths are 72" or less. Provide tie-rods for spans in excess of 72". This vane is acceptable at lower pressure classes and velocities. Non-adjustable, double wall 24-gauge vane per SMACNA Fig. Fig. 4-3 & 4-4. Vane runner shall be of the tabbed style and shall have bent, or winged tabs. Straight tabs are not permitted. Available Manufacturer: "C.L. Ward & Family Inc." Turning Vane and Speedy Rail, "Ductmate" PRORail.
- M. Seams: All seams shall conform to SMACNA standards for the corresponding pressure and seal class and to the requirements in this specification.
 - 1. Round and oval duct seams shall be spiral seam or continuous butt weld construction only.
 - 2. Rectangular seams for 3-in wg pressure class or higher shall be SMACNA L-1 Pittsburgh Lock or continuous butt weld only.
 - 3. Rectangular seams for 2-in wg pressure class or lower shall be continuous butt weld, SMACNA L-1 Pittsburgh Lock, or SMACNA L-2 Button Punch Snap Lock.
 - 4. Do not use standing seams for ducts other than plenums
- N. Joints: All joints shall conform to SMACNA standards for the corresponding pressure and seal class and to the requirements in this specification.
- O. Rectangular Joints: Provide prefabricated slide-on transverse duct connectors and components. Install per manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcement(s). Formed-on SMACNA flanges T-25a (T.D.C.) or T-25b (T.D.F.) will not be accepted.

1. Acceptable Manufacturers:
 - a. "Ductmate Industries" 25, 35, and 45
 - b. "Nexus" G and J
 - c. "W.D.C.I." J and H
 2. Rectangular joints for 2-in wg pressure class or lower may also be SMACNA
 - a. T-24 flanged with gasket
 - b. T-1 Drive Slip with T-5, T-6, T-10, T-11, or T-12 S Slip
- P. Round Joints: Factory fabricated transverse spiral and round duct joints conforming to SMACNA standards RT-1 through RT-6 are acceptable for ducts 20" in diameter and under. Prefabricated connectors for duct joints are permitted as noted below. Install per manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcement(s).
1. 3"-14" Diameter: Install duct with a one piece round duct connector that includes a polyethylene gasket liner and single bolt closure. "Ductmate Industries" Quick-Sleeve Round Duct Connector, "Ward Industries" Quick Connect Model QCC (up to 12" only), or approved equal.
 2. 14"-72" Diameter: Install duct using a three-piece, gasket flanged joint consisting of two internal flanges, with integral mastic sealant and one external closure band, which compresses the gasket between the internal flanges. "Ductmate Industries" Spiralmate or approved equal.
- Q. Flat Oval Joints: Factory fabricated transverse flat oval duct joints conforming to SMACNA standards are acceptable for ducts with a major axis of 20" or under. Prefabricated connectors for duct joints are permitted as noted below. Install per manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcement(s).
1. Roll formed minor axis (semicircular) flanges with integral sealant. Straight roll-formed flange with integral sealant cut to length for major axis sizes. Precision stamped connector pieces. Extruded Butyl or Neoprene gasket applied to the face of the mating flanges and screw-type cleats at manufacturer-specified intervals around perimeter of the connection. Approved manufacturers: "Ductmate Industries" Econoflange Oval Duct Connection System.
- Note: Edit the Duct Fitting Requirements detail as needed. This typically goes on sheet M0.1. Ask Owner if they want access panels at return and exhaust turning vanes for cleaning and inspection. This adds cost and is a potential leak site.
- R. See Duct Fitting Requirements detail on drawings for acceptable configurations for offsets, transitions, and take-offs.
- S. Diagonal Creasing for ducts 3-in wg or lower: Provide on all panels wider than 18". At Contractor's option, in place of diagonal creasing required for panels wider than 18", all such panels may have machine-formed transverse ribbed stiffening on 12" centers, provided such stiffening accomplishes stiffness and freedom from buckling or breathing, and does not lessen airtightness at seams and joints.
- T. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.

6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

U. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Characteristics: Type S, Grade NS, Class 25, Use O.
3. If low-emitting materials are required for LEED-NC Credit EQ 4.1: use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

V. Gaskets in Flanged Ducts: Use soft neoprene or extruded butyl.

Specify safety relief access doors as needed and show locations and pressure settings on the drawings. Fan systems with fire dampers are particularly susceptible to duct blowout or collapse, even with a high static cutout switch on the fan.

W. Safety Relief Access Doors: Provide positive and/or negative pressure safety relief access doors in ducts to prevent blowout or duct collapse. Provide at locations indicated on the drawings.

1. Acceptable Manufacturer: United McGill Airflow Corporation ARR or ASR or approved SMACNA design.

2.4 DOUBLE-WALL DUCT AND FITTING FABRICATION

A. Manufacturers:

1. Lindab Inc.
2. McGill AirFlow Corporation (K-27)
3. Or equal.

B. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.

1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.
2. Insulation: 2-inch- thick fibrous glass. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
 - a. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
3. Solid Inner Ducts: Use the following sheet metal thicknesses and seam construction:
 - a. Ducts 3 to 8 Inches in Diameter: 0.019 inch with standard spiral-seam construction.
 - b. Ducts 9 to 42 Inches in Diameter: 0.019 inch with single-rib spiral-seam construction.
 - c. Ducts 44 to 60 Inches in Diameter: 0.022 inch with single-rib spiral-seam construction.
 - d. Ducts 62 to 88 Inches in Diameter: 0.034 inch with standard spiral-seam construction.
4. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent. Provide Mylar or Tedlar layer to separate insulation from air stream.

5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.
- C. Fittings (from minus 2- to plus 10-inch wg): Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
1. Solid Inner Ducts: Use the following sheet metal thicknesses:
 - a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
 - b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
 - c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.
 2. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent. Provide Mylar or Tedlar layer to separate insulation from air stream.

2.5 SHEETMETAL MATERIALS

- A. Galvanized Steel: Steel sheets, G-60 zinc-coated (galvanized) or zinc-iron alloy coated (galvannealed) by the hot dip process, conforming ASTM A653 unless noted otherwise.
- B. Aluminum: Type 3003-H14. Comply with requirements of ASTM B209.
1. Rectangular Ductwork: Aluminum ductwork shall comply with the requirements of low pressure galvanized steel ductwork. Thickness adjustments of aluminum, including dimension adjustments and reinforcements needed to meet the construction requirement thickness of steel ducts, shall comply with SMACNA 1995 HVAC/DCS, Article 1.12.1, "Conversion of Steel Tables to Aluminum".
 2. Round Ductwork: Construction of aluminum duct and fittings shall otherwise correspond in the same relationship as for steel duct. Conform to SMACNA 1995 HVAC/DCS, Table 3-3, "Aluminum Round Duct Gage Schedule". Aluminum fasteners shall be used. Structural members shall be alloy 6061-T6 or galvanized steel as related in SMACNA Table 1-16 for rectangular duct. Hangers in contact with the duct shall be galvanized steel or aluminum.
- C. Stainless Steel: Unless indicated otherwise, Type 316L stainless steel, not to exceed 0.03% carbon, conforming to ASTM A240/A240M.

2.6 RECTANGULAR DUCT LINER

- A. Provide at locations shown on drawings.
- B. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
1. Available Manufacturers:
 - a. CertainTeed Corp.; Insulation Group "Ultra-Lite"
 - b. Johns Manville International, Inc "Linacoustic"
 - c. Knauf Fiber Glass GmbH., "Liner-M"
 - d. Pittsburg Plate Glass "Textrafine"
 - e. Owens Corning "Aeroflex"
 2. Acoustical Properties: The material shall be tested by an independent testing laboratory to determine the sound absorption coefficient in accordance with ASTM C423 using Type A mounting. The sound absorption coefficients shall meet or exceed the following values:

Octave Band Center Frequency Hz						
Thickness	125	250	500	1000	2000	4000
1"	0.13	0.45	0.45	0.65	0.74	0.90
2"	0.25	0.73	0.94	0.95	0.95	0.95

3. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
 - a. Thickness: 1 inch
 - b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
 - 1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
 - 2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
 - 3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

C. Flexible Elastomeric Duct Liner: Comply with NFPA 90A or NFPA 90B.

1. Available Manufacturers:
 - a. Aeroflex USA Inc.; Aerocell EDPM
 - b. Armacell; AP/Armaflex SA Duct Liner.
 - c. K-Flex USA; Duct Liner Grey.
2. Acoustical Properties: The material shall be tested by an independent testing laboratory to determine the sound absorption coefficient in accordance with ASTM C 423 with ASTM E 795 Type A mounting. The sound absorption coefficients shall meet or exceed the following values:

Octave Band Center Frequency Hz						
Thickness	125	250	500	1000	2000	4000
1"	0.00	0.08	0.32	0.55	0.23	0.21

3. Materials: Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.
 - a. Thickness: 1 inch.
 - b. Thermal Conductivity (k-Value): 0.24 at 75 deg F mean temperature.
 - c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
 - d. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

2.7 ROUND DUCT LINER

- A. Provide at locations shown on drawings.

- B. General: Comply with applicable requirements of acoustical lining for rectangular ductwork. Do not line underground round ducts.
- C. Acoustical Lining: 1" thickness unless otherwise shown. Increase duct dimension for lining. Liner shall be suitable for continuous operation at 4,000 fpm velocity with erosion and shall conform to UL 723, resistant requirements of NFPA Pamphlet No. 90 and Uniform Mechanical Code. The "R" value shall be 4.3 when tested in accordance with ASTM C518 at 75°F mean temperature.
- D. Manufacturer: Manville "Spiracoustic" or approved equal.
- E. Acoustical Properties: The material shall meet or exceed the following values using Type "A" mounting in accordance with ASTM C423-81.

Thickness	Octave Band Center Frequency (Hz)						
	125	250	500	1000	2000	4000	NRC
1"	.13	.28	.64	.88	.97	1.01	.70

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Coordination Drawings: Sheet metal duct installation shall be coordinated with other trades prior to installation in order to avoid conflict with the following other building elements:
 - 1. Ceiling suspension assembly members.
 - 2. Systems installed in same space as ducts (piping, electrical conduits, equipment, etc.).
 - 3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
 - 4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Fabricate and install ductwork and accessories in accordance with SMACNA Duct Construction Standards, Metal and Flexible.
 - 1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, terminal units, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide necessary fittings and offsets at no additional cost to the owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions, which shall be altered by the contractor to other dimensions with the same air handling characteristics (not less than same free area and pressure drop) where necessary to avoid interferences and clearance difficulties.
 - 2. Comply with the requirements of Section 230500, "Transitions and Offsets Beyond the Scope of Work".
- C. Provide Duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Duct Construction Standards, Metal and Flexible and with Duct Fitting Requirements detail on drawings.
 - 1. When an obstruction cannot be avoided and must be taken in by the duct, comply with SMACNA "Obstructions". Repair galvanized areas with galvanizing repair compound.

2. Construct casings, plenums, eliminators, and pipe penetrations in accordance with SMACNA Standards, Install plenum access doors to swing against air pressure so that pressure helps to maintain a tight seal.
- D. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
 - E. Install ducts with fewest possible joints.
 - F. Provide test holes at fan inlets and outlets, where required for balancing, and elsewhere as indicated.
 - G. Install fabricated fittings for changes in directions, size, and shape and for connections.
 - H. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
 - I. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
 - J. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 - K. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
 - L. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
 - M. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
 - N. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
 - O. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
 - P. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
 - Q. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."
 - R. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to Division 23, Section 230529, "Hangers Supports & Seismic Controls for Mechanical Components."
 - S. Paint interiors of metal ducts that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

T. New Ductwork Protection and Cleaning:

1. Each piece of shop-fabricated ductwork shall be cleaned of contaminants and oil residue before being sent to the job site.
2. Each piece of field-fabricated ductwork shall be cleaned of contaminants and oil residue. It shall then either be promptly installed or sealed with visqueen or "Ductcap Products Inc" caps and stored.
3. All ductwork stored on the jobsite shall remain sealed until it is installed. Unsealed sections of ductwork shall not be permitted to be stored or lying about the jobsite.
4. All ductwork shall be protected from moisture at all times.
5. All ends of installed ductwork shall be sealed with visqueen or "Ductcap Products Inc" caps at the end of each work day.

U. Existing Ductwork Protection and Cleanliness Evaluation:

1. All ends of existing ductwork that are exposed after demolition shall be sealed with visqueen at the end of each work day.
2. Notify A/E when the majority of existing ductwork demolition has been completed and remaining existing ductwork is available for evaluation. The Owner or their designated representative will evaluate the cleanliness of the existing ductwork. The Owner may then elect to hire a contractor to clean the existing ductwork before connections are made to the new system.

V. Ductwork Cleanliness Testing:

1. The Owner or their designated representative will visually observe the metal ducts for oil residue and contaminants. Where contaminants are discovered visually or by a white-glove test, the contractor is responsible for re-cleaning the ductwork before re-evaluation. Notify A/E when the majority of new ductwork has been installed, but before terminal units are connected and again before flexible ducts and diffusers are connected.
2. At the discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA Standard 1992-01 utilizing NIOSH Method 0500 vacuum test gravimetric analysis for total nuisance dust.
 - a. If analysis determines that levels of debris are equal to or lower than suitable levels (5.0 mg/m³ of particulates), system shall have passed cleanliness verification.
 - b. If analysis determines that levels of debris exceed suitable levels, system cleanliness will have failed and metal duct system shall be re-cleaned and re-tested at Contractor's expense.

3.2 Duct cleaning – new systems. This includes vacuuming of ducts, grds, coils, plenums, etc. Vacuum exhaust filtration is addressed.

3.3 Duct cleaning – existing systems. This includes vacuuming of ducts, grds, coils, plenums, and biocide treatments. Vacuum exhaust filtration is addressed.

3.4 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure and seal class indicated in Part 2 of this specification section.
- B. Seal ducts before external insulation is applied.

- C. Adhesive-backed cloth or metallic furnace tape will not be acceptable.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."

3.6 installation of sound liner in ducts

- A. Round Liner Fastening: Liner shall slip into interior of sheet metal round duct in sections; finish with male/female slip-joints for strong, snug connections between sections.

- B. Rectangular Fiberglass Liner:

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

- C. Closed-Cell Elastomeric Foam Liner:

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

6. Secure liner with mechanical fasteners four inches from corners and at intervals not exceeding 12 inches transversely; at three inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm (12.7 m/s) or where indicated.
8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

3.7 FIELD QUALITY CONTROL

- A. Air Supply and Distribution Systems: The air supply, return, and exhaust and distribution systems and its components shall be given an operational test.
- B. Leakage Testing of Ductwork: Perform the following field test(s) and inspections according to SMACNA "HVAC Air Duct Leakage Test Manual", prepare test reports, and submit for approval. Include final reports in the O&M Manual:
 1. Perform preliminary duct leakage test when ductwork is between 15% and 30% complete. The engineer shall select the section(s) of ductwork to be tested, or may elect to test all installed ductwork.
 2. Perform final duct leakage test of complete system, including supply, return, and exhaust ductwork.
 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, request clarification from the Engineer before constructing ductwork. Do not pressurize systems above maximum design operating pressure. Give seven days written advance notice for testing. Testing shall be repeated if conducted without required notice.
 5. Maximum Allowable Leakage: Pressure classes refer to both positive and negative in absolute values. Note that some of these requirements exceed default SMACNA leakage class values. Comply with requirements for Leakage Class 3 for round ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch w.g., and Leakage Class 6 for pressure classes from above 2-inch to 10-inch w.g.
 6. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.8 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 31 00

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.2 SUMMARY

- A. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. Motorized dampers.
4. Fire dampers.
5. Combination fire and smoke dampers.
6. Duct silencers.
7. Clean flow duct silencers.
8. Packless duct silencers.
9. Duct-mounted access doors.
10. Casing and Plenum access doors.
11. Flexible connectors.
12. Flexible ducts.

- B. Related Sections include the following:

1. Division 23, Section 23 09 00, "Instrumentation and Control for HVAC" for electric and pneumatic damper actuators.
2. Division 28, Section 28 31 11, "Fire Detection and Alarm" for duct-mounting fire and smoke detectors.
3. Division 23, Section "HVAC Ductwork and Casings" for test ports, stuffing boxes, turning vanes, joint sealant, and safety relief access doors.

1.3 SUBMITTALS

- A. Product Data: Submit for the following:

1. Backdraft dampers.
2. Volume dampers.
3. Motorized dampers.
4. Fire dampers.
5. Combination fire and smoke dampers.
6. Duct silencers.
7. Clean flow duct silencers.
8. Packless duct silencers.
9. Duct-mounted access doors.
10. Casing and plenum access doors.
11. Flexible connectors.
12. Flexible ducts.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Manual volume damper installations.
 - 2. Motorized dampers installation including actuator location and accessibility.
 - 3. Fire-damper, smoke-damper, and combination fire and smoke damper installations, including sleeves and duct-mounting access doors.
 - 4. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 SHEETMETAL MATERIALS

- A. Galvanized Steel: Steel sheets, G-60 zinc-coated (galvanized) or zinc-iron alloy coated (galvannealed) by the hot dip process, conforming ASTM A653 unless noted otherwise.
- B. Aluminum: Type 3003-H14. Comply with requirements of ASTM B209.
 - 1. Rectangular Ductwork: Aluminum ductwork shall comply with the requirements of low pressure galvanized steel ductwork. Thickness adjustments of aluminum, including dimension adjustments and reinforcements needed to meet the construction requirement thickness of steel ducts, shall comply with SMACNA 2005 HVAC Duct Construction Standards, Article 2.10.1, "Conversion of Steel Tables to Aluminum".
 - 2. Round Ductwork: Construction of aluminum duct and fittings shall otherwise correspond in the same relationship as for steel duct. Conform to SMACNA 2005 HVAC Duct Construction Standards, Table 3-14, "Aluminum Round Duct Gage Schedule". Aluminum fasteners shall be used. Structural members shall be alloy 6061-T6 or galvanized steel as related in SMACNA for rectangular duct. Hangers in contact with the duct shall be galvanized steel or aluminum.
- C. Stainless Steel: Unless indicated otherwise, Type 316L stainless steel, not to exceed 0.03% carbon, conforming to ASTM A240/A240M.

2.2 BACKDRAFT DAMPERS

- A. Basis of Design: Ruskin Model CBD6.
- B. Manufacturers:
 - 1. Ruskin Model CBD6
 - 2. Air Balance, Inc.
 - 3. American Warming and Ventilating.
 - 4. Greenheck.

- C. Description: Multiple-blade, low-leakage, parallel action gravity balanced, with blades of maximum six-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, molded synthetic bearings, and axles; adjustment device to permit setting for varying differential static pressure. Counterbalances shall be on rear of blades for weather resistance.
- D. Frame: 0.125-inch- thick extruded aluminum, with welded corners.
- E. Blades: 0.070-inch- thick aluminum sheet with 1/2" tie bar linkage
- F. Blade Seals: Extruded vinyl.
- G. Return Spring: Adjustable tension.
- H. Performance: Damper shall withstand a 3" water gauge pressure differential. Maximum leakage shall be 17.5 cfm/sf or less measured on 24" wide damper at a 1" w.g. differential pressure. Blade shall fully open at 0.05" w.g. Damper pressure drop shall be less than 0.1" w.g. at 1200 fpm.
- I. Backdraft Dampers in Fume Exhaust Ducts: Stainless steel, same as fume duct. Gauge same as fume duct.

2.3 VOLUME DAMPERS

- A. General Description: All volume dampers shall be factory fabricated with hardware and accessories. Stiffen damper blades for stability and include locking device to hold single-blade dampers in a fixed position without vibration. Dampers shall be free from any sharp edges that would produce excessive turbulence. Dampers must be rated for the service pressure drop, velocity, and temperature.
- B. Damper and Accessory Material: Same as metal duct.
- C. Single Blade Volume Dampers:
 - 1. Permitted only for rectangular ducts up to 36" wide and 12" high or round ducts up to 12" diameter.
 - 2. Rated for velocities up to 1500 fpm and pressure drops across damper of 1 in. wg. or less.
 - 3. Damper blade shall be minimum 22 gauge steel and shall be as close to full size as possible without binding. Both leading and leaving edges hemmed; side edges flanged 1/2"; placed so air strikes the smooth face.
 - 4. Damper shaft shall be minimum 3/8" square rod. Shafts shall be full length.
 - 5. Frame shall be min. 20 gauge steel channels with mitered and welded corners.
 - 6. Basis of Design: McGill AirFlow Corporation Models UVC8 and UVC9.
 - 7. Manufacturers:
 - a. McGill AirFlow Corporation Models UVC8 and UVC9.
 - b. Greenheck Models MBD-10 and MBDR-50
 - c. Ruskin
 - d. Young Regulator Company
- D. Rectangular and Square Opposed-Blade Volume Dampers:
 - 1. Provide for rectangular ducts over 36" wide or 12" high or round ducts over 12" diameter and where specifically designated on the drawings.
 - a. May be used in place of single blade volume dampers at contractor's option.

- b. Rated for velocities up to 2000 fpm and pressure drops across damper of 2 in. wg. or less.
 - c. Damper must be rated for the service pressure drop, velocity, and temperature.
 2. Round ducts shall be provided with transitions into and out of the square damper assembly.
 3. Damper blades shall be minimum 16 gauge galvanized steel. Both leading and leaving edges hemmed; side edges flanged 1/2"; placed so air strikes the smooth face.
 4. Damper shafts shall be minimum 1/2" square rod. Shafts shall be full length.
 5. Frames shall be min. 16 gauge galvanized steel structural or formed channels with mitered and welded corners.
 6. Basis of Design: McGill AirFlow Corporation Model UVC21.
 7. Manufacturers:
 - a. McGill AirFlow Corporation Model UVC21
 - b. Greenheck Model VCD-18
 - c. Ruskin
 - d. Young Regulator Company
- E. Bearings:
 1. Provide end bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
 2. Bearings shall be molded synthetic, oil-impregnated bronze, Zytel, or stainless steel.
 3. Basis of Design: Ventfabrics HiVel Ventlok.
 4. Manufacturers:
 - a. Ventfabrics HiVel Ventlok
 - b. Young Regulator Company
- F. Quadrants:
 1. Provided with a dial regulator, heavy gauge handle, and locking nut. Size to match shaft size.
 2. Provide elevated stand-off for use on all externally insulated ductwork.
 3. Basis of Design: Ventfabrics Ventline Quadrant.
 4. Manufacturer:
 - a. Ventfabrics Ventline Quadrant
 - b. Young Regulator Company
- G. Quadrants for Dampers in Ducts Concealed Behind Walls and Above Non-Removable Ceilings:
 1. Direct Controlled Dampers: Where possible, use direct controlled dampers. Damper regulator shall be cast into a box for flush mounting in ceilings. Cover telescopes into base to allow for expansion. Cover shall be secured by two screws to facilitate removal for adjustment of the damper. The regulator shall be made to accommodate 3/8" and 1/2" square rod.
 - a. Basis of Design: Young Regulator No. 301
 - b. Manufacturers:
 - 1) Young Regulator No. 301
 - 2) Ventfabrics No. 666
 - 3) Ruskin
 - 4) Nailor

2. Cable Controlled Dampers: Balancing dampers in ducts concealed behind walls and non-removable ceilings shall be provided with cable-controls if access to the regulator cannot be immediately adjacent to the damper. Damper controller and cable shall be concealed above the ceiling. Cable shall consist of Bowden cable 0.054" stainless steel control wire encapsulated in 1/16" flexible galvanized spiral wire sheath. Control kit shall consist of 2-5/8" diameter die cast aluminum housing with three-inch diameter cover, and 14-gauge steel rack and pinion gear drive converting rotary motion to push-pull motion. Control kit shall be imbedded in the ceiling flush with the finished surface. Control kit shall be manually operated with a wrench.
 - a. Basis of Design: Young Regulator Model 270-301 control kit and Model 030-12 wrench
 - b. Manufacturers:
 - 1) Young Regulator Model 270-301 control kit and Model 030-12 wrench.
 - 2) Ventfabrics

2.4 MOTORIZED DAMPERS

- A. Control Dampers: AMCA-rated, opposed blade design; 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall be heavy gage extruded aluminum, airfoil type, with maximum blade width of 6 inches and length of 48 inches.
 1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, blade-linkage hardware of zinc-plated steel and brass, ends sealed against molded synthetic blade bearings.
 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 3. Edge Seals, Low-Leakage: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 8 cfm per sq. ft. of damper area at differential pressure of four inch w.g. and a maximum of 3 cfm per sqft at one inch w.g. when tested according to AMCA 500D.
- B. Large damper assemblies shall be made of individually driven segments that are small enough to ensure reliable operation and uniform closure across the entire damper assembly. Actuators shall be operated independently so that if one damper segment or actuator becomes inoperable, the others remain operable (provide multiple end switches wired together so if a section fails, end switch will acknowledge). Jack shafts and linkages should not be necessary and can only be used if approved by Owner.
- C. See the failure mode section above for actuator responses under failure due to loss of power, loss of control air, or loss of communication. Where an actuator is to fail open or fail closed, provide spring return. Actuators shall not be dependent on batteries or capacitors to stroke to the power fail position upon loss of power.
- D. Permanently stamp or scribe position indication on the end of driven shaft unless damper is visible from same location as end of shaft.
- E. Actuators: See Section 230900 - INSTRUMENTATION AND CONTROL SYSTEMS.
- F. Manufacturer: Ruskin, American Warming and Ventilation or approved equal dampers.
 1. Control damper - Ruskin Industries Model CD50
 2. Smoke damper - Ruskin Industries Model SD50,

2.5 FIRE DAMPERS

- A. Basis of Design: Ruskin Company model DIBD2 Style B and DIBD23 Style B.

- B. Manufacturers:
 - 1. Ruskin Company model DIBD2 Style B and DIBD23 Style B.
 - 2. Air Balance
 - 3. Greenheck
 - 4. Nailor Industries
- C. Fire dampers shall be labeled according to UL 555, and NFPA 90-A. Dampers shall be factory fabricated and rated for 1-1/2 hours (DIBD2) and 3 hours (DIBD23).
- D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 20-Ga. galvanized steel; with mitered and interlocking corners. Horizontal damper mullions and head boxes are not permitted.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch thick as required for listing and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 24-Ga. thick, galvanized sheet steel. In place of interlocking blades, use full-length, 22 Ga. thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include stainless steel closure spring.
- I. Fusible Links: Replaceable, 165 degree F rated.
- J. Round or flat oval dampers shall be provided with collar for connection to duct and breakaway connection at housing.
- K. Dampers shall have not less than 90% free area for rectangular ducts and 100% free area for round and flat oval ducts. Manufacturer shall coordinate with contractor as to whether the height and/or width will be increased beyond the duct size to meet this requirement. See table below for dampers up to 1450 fpm.

Duct Height	Duct Width									
	8	12	16	20	24	28	32	36	40	42
6										
8	Add 4" w&h									
12										
16			Add 2" w&h							
20										
24										
28										
32							Damper same size as duct			
36										
40										
44										
48										
52										
56										
60										

2.6 COMBINATION FIRE AND SMOKE DAMPERS

- A. Basis of Design: Ruskin Company Model FSD60 (Rectangular Ducts) or Model FSDR25 (Round or Oval Duct)
- B. Manufacturers:
 - 1. Ruskin Company Model FSD 60 (Rectangular Ducts) or Model FSDR25 (Round or Oval Duct).
 - 2. Air Balance, Inc.
 - 3. Greenheck
 - 4. Nailor Industries
- C. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating. Linkage shall be concealed in frame.
- D. Dampers shall be Leakage Class I. Dampers in ducts smaller than 12" x 12" shall be Leakage Class II.
- E. Reusable, Resettable Links: Each combination fire smoke damper shall be equipped with a factory installed heat responsive device rated to close the damper when the temperature at the damper reaches 165 degree F.
- F. Frame: Min. 16 Ga. thick galvanized hat channel or min. 13 Ga. galvanized channel.
- G. Blades: Min. 14-Ga thick, galvanized sheet steel, horizontal, airfoil style. Provide silicone edge seal, mechanically locked to blade edge.
- H. Bearings: Self-lubricating stainless steel sleeve turning in an extruded frame hole.

- I. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- J. Dampers shall have not less than 90% free area for rectangular ducts and 100% free area for round and flat oval ducts. Manufacturer shall coordinate with contractor as to whether the height and/or width will be increased beyond the duct size to meet this requirement. See table below for dampers up to 1450 fpm.

Duct Height	Duct Width									
	8	12	16	20	24	28	32	36	40	42
6										
8	Add 4" w&h									
12										
16		Add 2" w&h								
20										
24										
28										
32						Damper same size as duct				
36										
40										
44										
48										
52										
56										
60										

- K. Electric Actuators: Appropriate electric actuators, two-position, 120 VAC, for tie in to smoke detection system shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity that meets all applicable UL555 and UL555S qualifications for both dampers and actuators. Damper and actuator assembly shall be factory cycled 10 times to assure operation. Actuators shall always move toward the full-open position when energized and always move toward the full-closed position when not energized. This requirement shall not be compromised by any combination of short-term power pulses.
- L. Pneumatic Actuators: Appropriate pneumatic actuators, two-position, shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity that meets all applicable UL555 and UL555S qualifications for both dampers and actuators. Provide an EP relay (24V electric-pneumatic) factory mounted with tubing to the heat closure device and actuator. Damper and actuator assembly shall be factory cycled 10 times to assure operation.
- M. Temperature Release Device: Heat-Actuated, Quick Detect.
- N. Smoke Management Controlled Closure.
- O. Blade Positioner Indicator
- P. Duct Smoke Detector

2.7 CLEAN FLOW DUCT SILENCERS

A. Rectangular Units:

1. Fabricate casings with a minimum of 0.034-inch- thick, solid galvanized sheet metal for outer casing and 0.022-inch- thick, ASTM A 653/A 653M, G60, perforated galvanized sheet metal for inner casing.
2. Basis of Design: Industrial Acoustics Company "Quiet Duct", Type HS or as specified.
3. Manufacturers:
 - a. Industrial Acoustics Company
 - b. Vibro-Acoustics
 - c. Dynasonics
 - d. VAW Systems

B. Round Units:

1. Basis of Design: Industrial Acoustics Company "Conic Flow", Type as specified.
2. Manufacturers:
 - a. Industrial Acoustics Company
 - b. Vibro-Acoustics
 - c. Dynasonics
3. Outer Casings:
 - a. ASTM A 653/A 653M, G60, galvanized sheet steel.
 - b. Up to 24 Inches in Diameter: 0.034 inch thick.
 - c. 26 through 40 Inches in Diameter: 0.040 inch thick.
 - d. 42 through 52 Inches in Diameter: 0.052 inch thick.
 - e. 54 through 60 Inches in Diameter: 0.064 inch thick.
 - f. Casings fabricated of spiral lock-seam duct may be one size thinner than that indicated.
4. Interior Casing, Partitions, and Baffles:
 - a. ASTM A 653/A 653M, G60, galvanized sheet steel.
 - b. At least 0.034 inch thick and designed for minimum aerodynamic losses.

C. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

D. Fill Material: Inert and vermin-proof fibrous material, packed under not less than five percent compression or Moisture-proof nonfibrous material. Erosion Barrier: Polymer bag enclosing fill and heat-sealed before assembly.

E. Fire Performance: Adhesives, sealants, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame-spread index and 50 for smoke-developed index when tested according to ASTM E 84.

F. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.

1. Do not use nuts, bolts, or sheet metal screws for unit assemblies.
2. Lock form and seal or continuously weld joints.
3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
4. Reinforcement: Cross or trapeze angles for rigid suspension.

G. Source Quality Control:

1. Static pressure loss of the silencers shall not exceed 0.3" and the values listed in the sound attenuator schedule at the airflow indicated.
2. Acoustic Performance: Testing must be performed by an independent laboratory according to ASTM E 477 and must meet or exceed the performance listed in the sound attenuator schedule.
3. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of at least 2000-fpm face velocity.
4. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.8 PACKLESS DUCT SILENCERS

- A. Basis of Design: Industrial Acoustics Company "Ultra-Pals Packless Silencers", Type as specified.
- B. Manufacturers:
 1. Industrial Acoustics Company "Ultra-Pals Packless Silencers", Type as specified.
 2. Vibro-Acoustics.
 3. Dynasonics.
 4. VAW Systems
- C. Materials:
 1. Unless otherwise specified, the silencers shall be constructed of Type #G-90 lockformer quality galvanized steel. The silencer casings shall be a minimum of #22 Gauge solid galvanized steel. The internal partitions shall be a minimum of #26 Gauge perforated galvanized steel.
 2. No sound absorptive material of any kind shall be used in the silencers. The silencers shall attenuate air-transmitted noise solely by virtue of controlled impedance membranes and broadly tuned resonators.
- D. Construction:
 1. Units shall be constructed in accordance with the ASHRAE Guide recommendations for high-pressure ductwork. Seams shall be lock formed and mastic filled. Rectangular casing seams shall be in the corners of the silencer shell to provide maximum unit strength and rigidity. Interior partitions shall be fabricated from single-piece, margin perforated sheets and shall have die-formed entrance and exit shapes to provide the maximum aerodynamic efficiency and minimum self-noise characteristics in the sound attenuator. Blunt noses or squared off partitions will not be accepted.
 2. The interior partitions shall be attached to the casing by means of an interlocking track assembly. Tracks shall be solid galvanized steel and shall be welded to the outer casing. Attachment of the interior partitions to the tracks shall be such that a minimum of four thicknesses of metal exist at this location.
 3. The track assembly shall stiffen the exterior casing, provide a reinforced attachment detail for the interior partitions, and shall maintain a uniform airspace width along the length of the silencer for consistent aerodynamic and acoustic performance.
 4. Sound attenuating units shall not fail structurally when subjected to a differential air pressure of 8" W.G. from inside to outside the casing.
- E. Acoustic Performance:

1. Silencer ratings shall be determined in a duct-to-reverberant room test facility, which provides for airflow in both directions through the test silencer in accordance with ASTM Specification E-477. The test facility shall be NVLAP accredited for the ASTM E477 test standard. Data from a non-accredited laboratory will not be acceptable. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves and test chamber sound absorption are eliminated.
2. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self-Noise (SN) Power Levels both for Forward Flow (air and noise in same direction) and Reverse Flow (air and noise in opposite directions) with airflow of at least 1000 fpm entering face velocity. Data for rectangular silencers shall be presented for tests conducted using silencers no smaller than the following cross-sections: 24"x24", 24"x30", or 24"x36".

F. Aerodynamic Performance:

1. Static pressure loss of the silencers shall not exceed 0.3" and the values listed in the sound attenuator schedule at the airflow indicated.
2. Airflow measurements shall be made in accordance with ASTM specification E 477 and applicable portions of ASME, AMCA, and ADC airflow test codes.
3. Airflow data shall be reported on the identical units for which acoustic data is presented.
4. Airtight construction where required shall be provided by use of a duct sealing compound on the job site, material and labor furnished by the contractor.

G. Certification: With submittals, the manufacturer shall supply certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance for Reverse and Forward Flow test conditions. Test data shall be for a standard product. All rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection upon request from the A/E.

H. Duct Transitions: When transitions are required to adapt silencer dimensions to connecting duct work, they shall be furnished by the installing contractor.

2.9 DUCT-MOUNTED ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Rectangular Duct Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Basis of Design: Ductmate Industries, Inc. "Square Framed Access Doors, Hinged and Cammed Model".
2. Manufacturers:
 - a. Ductmate Industries, Inc. "Square Framed Access Doors, Hinged and Cammed Model".
 - b. Air Balance Inc. "Series FSA"
 - c. Greenheck
 - d. McGill AirFlow Corporation Model ARB
 - e. Ruskin "SMACNA Standard"
3. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
4. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.

- C. Round Duct Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
 - 1. Basis of Design: Ductmate Industries, Inc. "Sandwich Access Door".
 - 2. Manufacturers:
 - a. Ductmate Industries, Inc. "Sandwich Access Door"
 - b. McGill AirFlow Corporation
 - 3. Frame: Galvanized sheet steel, with spin-in notched frame.
 - D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
 - E. Insulation: One-inch- thick, fibrous-glass or polystyrene-foam board.
- 2.10 Access Doors in Casings and Plenums:
- A. Construct in accordance with SMACNA 2005 HVAC Duct Construction Standards, Fig. 9-16. Doors shall be double-wall insulated type and shall be equipped with three heavy duty zinc plated steel strap type T-hinges and two latches with lever handle on outside and inside. Doors shall be gasketed.
 - 1. Basis of Design: Ductmate Industries, Inc. "Square Framed Access Doors, Hinged and Cammed Model"
 - 2. Manufacturers:
 - a. Ductmate Industries, Inc
 - b. Ventfabrics, Inc. "Ventlok"
 - c. Air Balance, Inc. Series FSA
 - B. Latches shall have lever handle and stud to accommodate door thickness with inside beveled flange to work against door frame to give compression. Latch escutcheon shall be sponge rubber gasketed, heavy duty zinc plated steel
 - C. Walk-in access doors in casing and plenum walls shall be minimum 20" x 72" size.
- 2.11 FLEXIBLE CONNECTORS
- A. Basis of Design: Ductmate Industries, Inc. "Proflex".
 - B. Manufacturers:
 - 1. Ductmate Industries, Inc. "Proflex"
 - 2. Ventfabrics, Inc. "Ventglas" (Indoor Installations) and "Ventlon" (Outdoor Installations).
 - 3. Duro Dyne Corp.
 - C. General: Provide fabric-type flexible connectors between fans and ducts or casings, fans and plenums, and where ducts are of dissimilar metals, as indicated and where required. Fabric shall comply with UL Standard 214 and shall be accepted by NFPA for vibration isolation connectors in duct systems per NFPA Standard 90.
 - D. Connectors at Indoor Installations: Connectors shall be made of heavy glass fabric double-coated with neoprene, weighing approximately 30 oz. per square yard. Flexible connections shall be securely fastened by zinc-coated iron cinch-type draw bands for round ducts. For rectangular ducts, the flexible connections locked to metal collars shall be installed using normal duct construction standards and according to SMACNA 2005 HVAC Duct Construction Standards.

- E. Connectors at Outdoor Installations: Connectors shall be same as specified for indoor installations except fabric shall be made of heavy glass fabric double-coated with Hypalon, weighing approximately 26 oz. per square yard.

2.12 FLEXIBLE DUCTS

- A. Manufacturers:
 - 1. Flexmaster U.S.A., Inc. 1M or approved.
- B. General: Flexible duct, including connectors, shall comply with UL181, Class I, and NFPA 90A and shall have acoustical performance acceptable to the Engineer. Installed duct shall not erode, delaminate or impart loose fibers or odors into the air stream. Internal positive working pressure shall be +10 in. w.g. Internal negative working pressure shall be -5 in. w.g. through 16" diameter and -1 in. wg. at 18" and 20" diameter.
- C. Materials: Flexible duct assembly shall consist of a strong and puncture resistant polyethylene inner liner and a high strength duct wall, mechanically locked together with a corrosive resistant galvanized helix to form a solid performing UL-181, Class 1 flexible duct, without the use of glue or adhesives.
- D. Insulation and Vapor Barrier: The factory-fabricated flexible duct shall have blanket-type insulation, having a C Factor of not more than 0.23. The insulation shall be sheathed with a reinforced metallized vapor barrier having a maximum permeability of 0.05 perm per ASTM E96, Procedure A. The vapor barrier jacket on the flexible duct shall be sealed to vapor barrier on the connecting sheet metal ducts. Joints shall be airtight slip joints sealed and secured with a clamp.
- E. Clamps: 175-lb test 6/6 nylon locking draw band at each end.
 - 1. Manufacturer: Panduit SLT10-LH-L, Ideal "Snaplock" or Ventlock "Suretite" No. 670.
- F. Acoustical Performance: Test reports from an independent laboratory showing that flexible ducts meet the performance specifications stated below. If manufacturer other than that specified is submitted, provide acoustical performance ratings for each size flexible duct. Acoustical performance testing shall be performed by an independent laboratory. The specified insertion loss and radiated noise reduction of flexible duct should be met when tested with a 6 foot length of straight duct less than 500 feet per minute velocity.

Type 1M INSERTION LOSS (dB)							
Duct Dia. In	Air Velocity	Octave Band Center Frequency (Hz)					
		125	250	500	1000	2000	4000
6	<500 fpm	7.4	15.2	31.3	40.4	33.5	20.7
8	<500 fpm	5.6	10.6	23.9	34	22.5	17
12	<500 fpm	6.6	27.8	22.8	29.0	18.7	10.9

Type 1M INSERTION LOSS WITH 90 DEG. ELBOW (dB)							
Duct Dia. In	Air Velocity	Octave Band Center Frequency (Hz)					
		125	250	500	1000	2000	4000
6	<500 fpm	4.2	310.4	28.1	40	35.4	21.9
8	<500 fpm	1.3	19	34.5	35.5	25.6	16.5
12	<500 fpm	3.2	26.6	29.1	30.5	23	11.8

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible".
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel except when another material is specifically specified (Example: aluminum made damper in galvanized duct), stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Volume Dampers:
 - 1. Contractor shall set and lock all dampers in the "Full Open" position prior to balancing work.
 - 2. Mount volume damper quadrants and end bearings so that the fasteners do not limit full damper travel.
 - 3. Provide volume dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing.
 - 4. Install volume dampers as far from the outlet as possible while maintaining at a minimum of two duct widths from branch takeoff. Install at a point where the duct is accessible, if possible; axis of the blade the long dimension.
- D. Backdraft Dampers: Install on all exhaust fans or exhaust ducts nearest to outside that are not specified to have automatic dampers and elsewhere as indicated.
- E. Fire and Smoke Dampers:
 - 1. Install with fusible links, according to manufacturer's UL-approved written instructions to conform to the installation used for the rating test.
 - 2. Leave dampers in full open position.
 - 3. Inspect areas to receive dampers. Notify engineer of conditions that would adversely affect the installation or subsequent utilization of the dampers. Do not proceed with installation until unsatisfactory conditions are corrected.
 - 4. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The installing contractor shall furnish access doors in ductwork or plenums to provide this access for inspection, repair and cleaning.

5. The fire dampers and combination fire/smoke dampers are specified to have not less than 90% free area. Provide suitable duct transitions to accommodate damper collar size. Duct transitions shall comply with SMACNA 2005 HVAC Duct Construction Standards and the duct fittings/transition legend on the drawings.
 6. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.
 7. Contractor shall locate dampers on "as-built" drawings.
 8. Break-away duct connections shall meet UL requirements and SMACNA 5th Ed. 2002 Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems. Ductmate joints shall be unbolted and utilize plastic clamps.
 9. TDC/TDF joints may not be connected to the rough edge of a fire damper to form a break-away connection.
- F. Duct Silencers: Install rigidly to ducts. Maintain straight duct upstream and downstream of silencer, as shown on plans, to achieve actual installed pressure drop listed in equipment schedule.
- G. Access doors are required, but not typically shown on the drawings.
1. Install duct access doors on side of duct to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - a. Upstream of duct mounted coils, smoke detectors, and humidifiers.
 - b. Adjacent to back draft dampers, providing access to adjust counterbalances.
 - c. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
 - d. Adjacent to automatic control dampers.
 - e. At turning vanes in return and exhaust ductwork.
 - f. For cleaning operating room supply air duct and kitchen hood exhaust duct, locate access doors at 20-foot intervals and at each change in duct direction.
 2. Install the following sizes for duct-mounting, rectangular access doors:
 - a. One-Hand or Inspection Access: 8 by 5 inches.
 - b. Two-Hand Access: 12 by 6 inches.
 - c. Head and Hand Access: 18 by 10 inches.
 - d. Head and Shoulders Access: 21 by 14 inches.
 - e. Body Access: 25 by 14 inches.
 - f. Body Plus Ladder Access: 25 by 17 inches.
 3. Install the following sizes for duct-mounting, round access doors:
 - a. One-Hand or Inspection Access: 8 inches in diameter.
 - b. Two-Hand Access: 10 inches in diameter.
 - c. Head and Hand Access: 12 inches in diameter.
 - d. Head and Shoulders Access: 18 inches in diameter.
 - e. Body Access: 24 inches in diameter.
 4. Label access doors according to Division 23, Section 23 05 53, "Identification for HVAC Piping and Equipment."
- H. Flexible Connectors:
1. Install immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
 2. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- I. Flexible Ducts:

1. Refer to SMACNA 2005 Standards, Chapter 3. Ducts shall be continuous, single piece at least 6 and no more than 8 feet long. Ducts shall have at least one, but not more than two, 90° elbows. Centerline radius of bends shall be not less than two duct diameters. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor penetrations fire rated one hour or two hour.
2. Comply with SMACNA support standards and the requirements below.
 - a. Provide 2" wide sheet metal or "Saddle-Strap" non-metallic strap hangers maximum four feet on center. More frequent supports may be required to meet sag limitation.
 - b. Maximum permissible sag is 1/2" per foot of spacing.
 - c. Hangers shall be adequately attached to the building structure. Do not attach hangers to piping, ducts, or conduit.

3.2 INSTALLATION-devices furnished under other sections

- A. Motorized Dampers: Install all motorized dampers. Coordinate best location prior to ductwork fabrication and provide damper-manufacturer recommended straight duct length upstream and downstream. Dampers in ductwork and in plenums shall be provided with sheet metal closures all around the dampers frame, including mullions. Seal perimeter of damper frame closures with fire-retardant mastic for airtight closure. Construction and airtightness must be suitable for duct pressure class used. Multiple damper sections shall be bolted together and reinforced at joints with steel angles or channel mullions.
- B. Smoke Detectors: Install all smoke detectors furnished by the control contractor or electrical contractor. Review smoke detector submittals and advise manufacturer of anticipated air velocity range. Coordinate best location prior to ductwork fabrication and provide detector-manufacturer recommended straight duct length upstream and downstream. Provide adequate clearance for service and removal.
- C. Field-Installed Mixing Damper Installation:
 1. Install mixing dampers specified as part of this section or as furnished by others.
 2. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
 3. Assemble multiple sections of dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
 4. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
 5. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- D. Air Flow Measuring Devices:
 1. Install units specified as part of this section or as furnished by others.
 2. Install with minimum straight run distances, upstream and downstream as recommended by the manufacturer. Notify engineer at submittal time if required distances do not appear to be sufficient.

3.3 EQUIPMENT AND MATERIALS PROTECTION

- A. Adequately protect equipment and materials against physical damage. Place equipment and materials in first class operating condition, or return to source of supply for repair or replacement, as determined by the engineer. Protect all equipment and materials from moisture at all times. Protect during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

3.4 TESTING

- A. Combination Fire Smoke Damper Tests: After installation, all combination fire smoke dampers and all associated controls shall be tested to prove correct control, installation and that damper blades move freely within the confines of the damper frame and do not slip on their shafts. Contractor shall submit a signed statement in O&M Manuals certifying all dampers to be operational.

3.5 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23, Section 23 05 93, "Testing, Adjusting, and Balancing for HVAC."

3.6 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 33 00

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SECTION 23 36 00

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Single Duct air terminal units.
 - 2. Series Fan-powered air terminal units.
 - 3. Tracking Return/Exhaust terminal units.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 4. Primary service access opening.
- D. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data" include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.5 COORDINATION

- A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Envirotech/Johnson Controls
 - 2. Krueger
 - 3. Nailor
 - 4. Price
 - 5. Titus
 - 6. Trane

2.2 Air Terminal Units

- A. Terminal Unit Types:
 - 1. Single Duct Terminal Units: Furnish and install the single duct variable-air volume and constant volume terminal units as scheduled or indicated on the drawings. Terminals shall be equipped with heating coils.
 - 2. Dual Duct Terminal Units
 - 3. Series Fan Terminal Units: Furnish and install constant-volume series type fan-powered terminal units as scheduled or indicated on the drawings. Units shall be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Terminals shall be equipped with heating coils
If more than one type of fan terminal is used, make sure schedules identify type.
 - 4. Low Profile, Series Fan Terminal Units:
 - 5. Parallel Fan Terminal Units:
 - 6. Low Profile Parallel Fan Terminal Units:
 - 7. Tracking Return/Exhaust Terminal Units: Furnish and install the slide-in "retrofit" style variable air volume terminal units of the sizes scheduled and indicated on the drawings. The retrofit terminal shall be designed to slide into the side of ductwork, with a maximum 10" length of duct opening required. Gaskets shall be attached to the terminal to provide a seal against inner duct wall. No additional components shall be required inside the ductwork for mounting. A flange shall be provided for fastening the terminal to the ductwork with sheet metal screws. A damper position indicator shall be formed into the end of the shaft for easy monitoring of damper position.

B. General Requirements:

1. The entire terminal unit shall be designed and built as a single unit including motor and fan assembly and filters (if applicable), primary air damper assembly, water or electric heating coils, and accessories as shipped.
2. Unit shall be shipped as a complete assembly requiring no field assembly (including accessories).
3. All electrical components shall be UL listed and installed in accordance with the UL Standard 1995. Electrical connection shall be single point. All electrical components, including low voltage controls, shall be mounted in sheet metal control enclosures. The entire terminal shall be ETL listed as a complete assembly.

C. Terminal Casing:

1. The casing discharge shall be slip and drive for attachment to metal ductwork. Casing shall be provided with hanger brackets for rods or straps as directed by the Seismic Engineer. Unit casing shall have bottom access door that allows servicing of unit without disturbing duct connections.
3. Unit casing shall have round duct collar for the primary air connection and a rectangular discharge air connection suitable for flanged duct connection.
4. All control components shall be factory installed and mounted.

D. Terminal Lining:

1. Double Wall Insulated Casing: The terminal casing shall be minimum 20-gauge galvanized steel. The units shall be lined with 1" thick dual density insulation, meeting UL 181 and NFPA 90A, enclosed between the unit casing and a non-perforated internal 22 gauge sheetmetal cover extending over the fiberglass insulation, as well as covering the liner cut edges. The casing discharge shall be slip and drive for attachment to metal ductwork. The casing shall be designed for hanging by metal straps.
2. **OR** Fiber-Free Liner: The terminal casing shall be minimum 20-gauge galvanized steel. Internal liner shall be 1-inch minimum thickness, 1.5-lbs./ft.³ density polymer foam insulation. Exposed fiberglass is not acceptable. Insulation shall comply with UL 181 and NFPA 90A. The insulation shall be mechanically fastened to the unit casing. The casing discharge shall be slip and drive for attachment to metal ductwork. The casing shall be designed for hanging by metal straps.

E. Sound Performance:

1. Manufacturer shall submit sound power levels for each size terminal unit. Provide radiated and discharge NC level based on 1-inch inlet static pressure. Sound performance shall be ARI certified. The radiated and discharge path attenuation function shall be based upon factors found in ARI Standard 885-98. No additional attenuation factors shall be deducted from the sound power.

F. Fans:

1. Fans shall be constructed of steel and have a forward curved, dynamically balanced wheel with direct drive motor.
2. Motor:
 - a. Motors shall be suitable for the voltage and phase indicated on the schedule, 60 cycle. The motor shall be of energy-efficient design, permanent split capacitor type, with integral thermal overload protection and permanently lubricated bearings. Fan assembly shall include an anti-backward rotation device, torsion flex tuned spring steel suspension, and isolation between motor and fan housing.

- 1) Motor Speed Control: The terminals shall utilize a manual SCR that allows continuously adjustable fan speed from maximum to minimum, as a means of setting fan airflow. Setting airflow with any device that raises the pressure across the fan to reduce airflow is not acceptable. The speed control shall incorporate a minimum voltage stop to ensure that the motor cannot operate in a stall mode.
 - b. **OR** Motors shall be General Electric ECM variable speed DC brushless motors specifically designed for use with single phase, 277-volt, 60-Hertz electrical input. Motor shall be complete with and operated by a single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be direct coupled to the blower. Motor shall maintain a minimum of 70% efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.
- G. Primary Air Damper Assembly: The primary air damper assembly shall be heavy gauge steel with shaft rotating in Delrin self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent over-stroking, and a synthetic seal to limit close-off leakage to the maximum values shown below:

Inlet Size	Damper Leakage CFM		
	1.5" ΔPs	3.0" ΔPs	6.0" ΔPs
6	4	5	7
8	4	5	7
10	4	5	7
12	4	5	7
14	4	6	8
16	5	7	9

- H. Digital Controls
- 1. The terminals shall be equipped with pressure independent direct digital controller furnished by the control contractor and mounted by the terminal unit manufacturer. The control contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware, and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule on the drawings, to the terminal manufacturer.
 - 2. The terminal manufacturer shall provide pneumatic velocity sensors. The sensor shall be multi-point center averaging type, with a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03" w.g. at an inlet velocity of 500 fpm.
 - 3. The terminal manufacturer shall provided a UL Class II 24 VAC transformer and disconnect switch for all fan terminal units and for single duct terminal units with electric heaters.
- I. **OR** Pneumatic Controls:

1. The terminal units shall be equipped with pressure independent pneumatic controls which can be reset to modulate airflow between zero and the maximum catalogued cfm. Maximum airflow limiters are not acceptable.
 2. The terminals shall incorporate multi-point, center averaging velocity sensors. A minimum of four measuring ports must be parallel to the takeoff point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03" w.g. at inlet velocities of 500 fpm. The sensor must provide control signal accuracy of $\pm 5\%$, with the same size inlet duct at any inlet condition.
 3. Velocity controllers shall have a constant reset span regardless of minimum and maximum cfm setpoints. Span must be adjustable from 3 to 13 psi. Each controller shall be field convertible for direct or reverse acting without re-calibration. Controllers shall include reversing relay and selector switch. Total air consumption for controls shall not exceed 1.2 SCFH, single duct or 2.4 SCFH dual duct at 20 psig. Control devices shall be provided by the terminal manufacturer.
 4. Control devices shall be factory set for the scheduled minimum and maximum flow rates. Flow measuring taps and flow curves shall be supplied with each terminal for field balancing airflow. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be equipped with labeling showing unit location, size, minimum and maximum cfm setpoints, damper fail position, and thermostat action.
 5. Control devices shall be factory set and calibrated for operation with the room thermostats furnished by the control contractor.
 6. The terminal control damper shall be factory set to fail to open **OR** closed position in case of a loss of control air pressure.
- J. Hot Water Heating Coils: Hot water heating coils shall be enclosed in a minimum 20-gauge galvanized steel casing, with flanged construction for attachment to metal ductwork. Coils shall be factory-installed on the terminal. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to the tubes. Tubes shall be copper with minimum wall thickness of 0.016", with male solder header connections. Coils shall be leak-tested to 300-psi, with minimum burst pressure of 2000-psi at ambient temperature. Coils shall be provided with a minimum of two rows with circuits sized as required to provide heating capacity and performance as scheduled on the drawings. Coil performance data shall be based on tests run in accordance with ARI Standard 410.
- K. Filters: Fan terminals shall have prefilter at terminal unit ceiling plenum inlet. A filter holding frame sized to accommodate the largest filter possible shall be provided at the inlet casing and shall permit removal in the limited access space available. Initial filter pressure drop shall not exceed 0.20" at the design airflow indicated on the schedule. Provide 2-inch thick **OR** 4-thick prefilter.
- 2.3 SOURCE QUALITY CONTROL
- A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.
 - B. Verification of Performance: Rate air terminal units according to ARI 880.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- B. Electric isolation shall be provided between dissimilar metals for the purpose of minimizing galvanic corrosion.
- C. Each terminal unit shall be identified in accordance with the identification system indicated on the schedule or drawings with labels complying with Division 23 Section "Identification for HVAC Piping and Equipment". Identification on unit shall be readable from the floor through the primary service access opening.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air terminal units to allow service and maintenance.
- C. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange OR per detail on the drawings.
- D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts and Casings."
- E. Ground units with electric heating coils according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils 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 proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - a. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - b. Verify that controls and control enclosure are accessible.
 - c. Verify that control connections are complete.
 - d. Verify that nameplate and identification tag are visible.
 - e. Verify that controls respond to inputs as specified.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Refer to Division 01 Section "Demonstration and Training."

3.6 COMMISSIONING

A. Notify the Commissioning Agent one week prior to startup of equipment.

B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.

C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 36 00

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SECTION 23 37 00

AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 2 - PRODUCTS

2.1 DIFFUSERS

- A. General: Diffusers shall be sizes and mounting types shown on drawings and as scheduled. All diffusers shall be provided with earthquake tabs where required by code. Whether required by code or not, all diffusers shall be provided with earthquake tabs if the weight of the assembly (including all accessories and the plenum above) is more than fifteen (15) pounds unless the assembly is rigidly attached to, and can be fully supported from, a fully-supported sheet-metal duct or plenum.
- B. Square Face Modular Core Adjustable Diffusers:
 - 1. 1, 2, 3, or 4-way adjustable discharge pattern, steel construction, square or rectangular neck.

2. Back pan shall be one-piece stamped heavy gauge steel. Diffuser neck shall have 1-inch minimum depth to facilitate duct connection.
3. Diffuser core shall consist of fixed louver directional modules, which can be easily repositioned without tools in the field for 1, 2, 3, or 4-way discharge. Each module shall be easily removable to adjust the dampers in neck of the diffuser.
4. Manufacturers: Titus Model MCD, Anemostat RMD, Krueger 1240, Price MCD, Metalaire. Linear Slot Diffusers and Matching Returns:
 1. The frame and support bars of the linear diffusers shall be constructed of heavy gauge extruded aluminum. The pattern controller shall be an aerodynamically curved "ice-tong" shaped steel deflector.
 2. Pattern deflectors shall provide a 180° pattern adjustment. Pattern deflectors shall be positive positioning when providing a horizontal air path. Constant static pressure shall be maintained at a fixed volume under all positions of pattern adjustment.
 3. Margins and Joints: Diffuser margins shall be furnished to overlap or recess the opening as required to fit the ceiling finish. Mounting frame, if required, shall be provided with positive holding concealed fasteners. When required for plaster openings, frames shall be provided with rigid bracing to maintain the opening size. Diffusers and mounting frames shall be provided in one continuous piece up to 6' in length. Continuous diffuser sections shall butt with hairline joints and be provided with interlocking splines. Diffuser margins shall be mechanically fastened to provide a neat hairline corner appearance. Heavy gauge extruded aluminum end borders, end caps, and mitered corners shall be provided to close off the ends of the diffusers. When provided with plaster frames, butt joints of diffusers and plaster frames shall be staggered. Screws, bolts, etc., shall not be used in exposed face of diffusers and return models.
 4. The linear return models shall be constructed the same as supply diffusers without the pattern controllers.
 5. Volume Dampers: Volume dampers shall be provided behind all active supply diffusers and return models in each slot opening. Mitered corner sections shall have blank-off baffles. Inactive sections shall be blanked with integral volume dampers. Maximum damper length shall be 24".
 6. Finish:
 - a. Color anodized, anodic hard-coat, color as selected by the Architect. The pattern controller shall be coated dull black to accent the slot opening.
7. Manufacturers:
 - a. Linear diffusers with 1/2" wide multiple slots
 - 1) Titus Model ML 37
 - 2) Anemostat SLAD-F-50
 - 3) Carnes CHBB
 - 4) Krueger 1950
 - 5) Price SDS50
 - 6) Metalaire.
 - 7) Nailor.
 - b. Linear diffusers with 3/4" wide multiple slots
 - 1) Titus Model ML 38
 - 2) Anemostat SLAD-F-75
 - 3) Carnes CHDB
 - 4) Krueger 1975
 - 5) Price SDS75
 - 6) Metalaire.
 - 7) Nailor.
 - c. Linear diffusers with 1" wide multiple slots

- 1) Titus Model ML 39
- 2) Anemostat SLAD-F-100
- 3) Carnes CHFB
- 4) Krueger 1910
- 5) Price SDS100
- 6) Metalaire.
- 7) Nailor.

d. Linear returns with 1/2" wide multiple slots

- 1) Titus Model MLR 37
- 2) Anemostat SLAD-FR-50
- 3) Carnes CRBB, Krueger 1950R
- 4) Price SDR50
- 5) Metalaire.
- 6) Nailor.

e. Linear returns with 3/4" wide multiple slots

- 1) Titus Model MLR 38
- 2) Anemostat SLAD-FR-75
- 3) Carnes CRDB
- 4) Krueger 1975R
- 5) Price SDR75
- 6) Metalaire.
- 7) Nailor.

f. Linear returns with 1" wide multiple slots

- 1) Titus Model MLR 39
- 2) Anemostat SLAD-FR-100
- 3) Carnes CRFB
- 4) Krueger 1910R
- 5) Price SDR100
- 6) Metalaire.
- 7) Nailor.

D. Plenums for Linear Slot Diffusers and Returns:

1. Plenums shall be same manufacturer as linear diffuser manufacturer, designed specifically for field attachment of the specified diffusers. Plenums shall be galvanized steel construction and shall included a factory drawn (not welded) side inlet to fit 1, 2, 3, or 4-slot diffusers of slot width as scheduled. Standard nominal length shall be 2, 3, 4, or 5 feet, as scheduled.
2. Where specified, enhanced spread performance plenums shall be provided. Plenums shall have internal baffles to maximize air diffusion by shortening the throw and widening the spread of the discharge air.
3. Plenums shall be internally insulated when required by schedule or as indicated. Refer to acoustical lining specified earlier in this section for acceptable liners.
4. Field mounted inlet dampers, provided by plenum/diffuser manufacturer shall be furnished when specified or scheduled.
5. Manufacturers:
 - a. Uninsulated Plenums:
 - 1) Titus Model MP
 - 2) Anemostat SLAD-A
 - 3) Carnes CXPA-N
 - 4) Krueger TBS 1900
 - 5) Price SDB

- 6) Metalaire.
- 7) Nailor.

Research is advised for actual lining provided with the following models.

- b. Insulated plenums: To the extent that insulation meets requirements specified for duct acoustic lining;
 - 1) Titus MPI
 - 2) Anemostat SLAD-A
 - 3) Carnes CXPA-R
 - 4) Krueger TBSI 1900
 - 5) Price SDBI
 - 6) Metalaire.
 - 7) Nailor.

E. Plenum Slot Diffusers:

1. Plenum slot diffusers shall be provided uninsulated or insulated, as indicated or scheduled. The return models shall have the same face appearance as the supply models. Units shall be compatible with 9/16" architectural narrow tee ceiling systems. Diffusers shall have 1/2", 3/4", 1", 1-1/4", or 1-1/2" slot widths and be available with 1 or 2 parallel slots. Standard nominal lengths shall be 2 feet or 4 feet. Plenum diffusers shall include end cap mounting clips to match specified ceiling tee (and a cross notch on 4 foot units). Units shall be constructed of 24-gauge steel. The standard finish shall be black on the face of the diffuser and pattern controllers of supply models.
2. Each supply slot of diffuser shall have an extruded aluminum pattern controller with a tight sealing gasket edge at the top of the blade, which seats against the plenum wall or slot divider and provides full horizontal flow. The pattern controller shall be field adjustable from the face of the diffuser to change the discharge from horizontal to vertical. The slot face shall be constructed of double metal thickness for rigidity.
3. The plenum inlet on supply models shall be drawn from the plenum wall. Welded-in or mechanically fastened inlets are not acceptable. The inlet shall have at least 1-1/8" depth for duct connection.
4. Plenums shall be internally insulated when required by schedule or as indicated. Refer to acoustical lining specified earlier in this section for acceptable liners.
5. Manufacturers:
 - a. Uninsulated Plenum Slot Diffusers:
 - 1) Titus Model TBD-80-NT
 - 2) Price TBD
 - 3) Kees
 - 4) Metalaire.
 - 5) Nailor.
 - b. Insulated Plenum Slot Diffusers: To the extent that insulation meets requirements specified for duct acoustic lining;
 - 1) Titus Model TBDI-80-NT
 - 2) Price TBDI
 - 3) Kees
 - 4) Metalaire.
 - 5) Nailor.
 - c. Plenum Return Slot Units:
 - 1) Titus Model TBR-80-NT

- 2) Price TBDI
- 3) Kees
- 4) Metalaire.
- 5) Nailor.

F. Critical Environment Diffusers:

1. Diffusers shall be laminar flow type. Face of the diffuser shall be constructed of 0.040" thick aluminum and shall be perforated with 3/32" diameter holes on 1/4" centers. The free area of the face shall be 13%.
2. Diffuser shall be constructed using a 6" tall maximum back pan. The back pan shall have integral hanger tabs and safety cable for securing the unit to overhead structure.
3. Each unit shall have an integral internal baffle for evenly distributing air over the entire face of the diffuser. An integral volume damper shall be accessible through the face of the diffuser. Each diffuser shall have a removable center plug for adjusting the damper.
4. The diffuser shall be secured in place by 1/4-turn fasteners for quick removal and sanitizing.
5. Finish shall be manufacturer's standard white.
6. Size of the ceiling diffuser module shall be as indicated.
7. Manufacturer:
 - a. Titus Model TLF.

G. Radial Diffuser

1. Diffuser shall be high-volume, low velocity radial air diffusion diffuser with standard white finish, perforated face, and internal pattern controllers.
2. Construction shall be steel, 22-gauge backpan. Diffuser shall be configured for one-way hemispherical pattern in a lay-in ceiling.
3. Provide earthquake tabs and retainer cable. Provide gasket where diffuser meets ceiling and seal air-tight.
4. Manufacturer:
 - a. Titus Model Tri Teclf using the remote thermostat (Adds ~\$250) on the Thermally Powered Variable Diffusers, coordinate and specify who provides the line voltage wiring to the transformer, the transformer, and the low voltage wiring between the transformer, thermostat, and diffuser. Several diffusers can share the same transformer. Suggest having Mechanical Contractor provide low voltage wiring and Electrical Contractor provide line voltage wiring. The transformers can come from the Electrical Contractor or the diffuser manufacturer. If you are using a constant volume AHU or RTU, you must either install a bypass or limit the amount of closure of each diffuser. This will maintain the minimum AHU or RTU airflow when the diffusers close down. This can be done with a schedule or note on the drawings so the balancer knows what to do.

H. Thermally Powered Variable Diffusers

1. Diffusers shall be square face, round-neck design, complete with integral thermally powered thermostats, warm-up controller, and sliding sleeve type VAV control dampers. Finish shall be off-white enamel.
2. Units shall be nominal 24"x24" face size for lay-in installation in a standard exposed-grid ceiling suspension system.
3. Thermal elements shall be field adjustable through the face of the diffuser through a temperature range of 70°F to 78°F and static pressures of 0.02" w.g. to 0.5" w.g.
4. Diffusers shall have remote field adjustable thermostat for minimum and maximum air flow (cfm) setpoints.
5. Manufacturer:

- a. Thermal Products Corporation VFS 24 Series "Vari-Flow"
- b. Acutherm Therma-Fuser TF-HC-A.

2.2 Grilles and registers

- A. General: Grilles and registers shall be sizes and mounting types shown on drawings and as scheduled.
- B. Steel Supply Grilles:
 1. Grilles shall be double deflection type unless indicated otherwise on the drawings. Exposed deflection blades shall be horizontal when viewed from the room (typically, the first dimension indicated is the horizontal dimension).
 2. Grilles shall be steel construction with a 1-1/4" wide border on all sides, having a minimum thickness of 20-gauge. Screw holes shall be countersunk. Corners shall be welded with full penetration resistance welds with a reinforcing steel patch for extra strength.
 3. Deflection blades shall be constructed of heavy-duty aluminum spaced on 3/4" centers. Blades shall extend completely through the side frame on each side to provide stability throughout the complete CFM operating range of the grille. Blades shall be individually adjustable without loosening or rattling, and shall be held in place with tension wire.
 4. Manufacturers:
 - a. Double deflection, blades parallel to long dimension:
 - 1) Titus Model 300RL
 - 2) Price
 - 3) Nailor
 - b. Double deflection, blades parallel to short dimension:
 - 1) Titus Model 300RS
 - 2) Price
 - 3) Nailor
 - c. Single deflection, blades parallel to long dimension:
 - 1) Titus Model 301RL
 - 2) Price
 - 3) Nailor
 - d. Single deflection, blades parallel to short dimension:
 - 1) Titus Model 301RS
 - 2) Price
 - 3) Nailor
- C. Wall-mounted Steel Return and Exhaust Grilles:
 1. Grilles shall have fixed deflection blades, which shall be horizontal when viewed from the room (typically, the first dimension indicated is the horizontal dimension).
 2. Grilles shall be steel construction with a 1-1/4" wide border on all sides, having a minimum thickness of 20-gauge. Screw holes shall be countersunk. Corners shall be welded with full penetration resistance welds with a reinforcing steel patch for extra strength.
 3. Blades shall have a formed curvature, laboratory tested and certified for performance. Blades shall be 20-gauge minimum construction. Fixed deflection angle shall be 35°.
 4. Where indicated, integral opposed blade dampers shall be provided, constructed of heavy gauge steel. Damper shall be operable from the face of the grille.

5. Borders of grilles shall be suitable for installation surface and materials. Border type shall be surface mount or otherwise as indicated or required for the associated surface. Verify border requirements.
6. Manufacturers:
 - a. 35° Deflection, 3/4" Spacing, Blades Parallel to Long Dimension:
 - 1) Titus Model 350RL
 - 2) Anemostat
 - 3) Carnes
 - 4) Krueger
 - 5) Price
 - 6) Metalaire.
 - 7) Nailor
 - b. 35° Deflection, 3/4" Spacing, Blades Parallel to Short Dimension:
 - 1) Titus Model 350RS
 - 2) Anemostat
 - 3) Carnes
 - 4) Krueger
 - 5) Price
 - 6) Metalaire.
 - 7) Nailor

D. Ceiling-mounted Steel Return and Exhaust Grilles:

1. Except as noted below, grilles shall be the same as specified for wall-mounted grilles.
2. Grilles in lay-in ceilings shall not have screw holes in the border.
3. Grilles shall have fixed deflection blades, which shall be perpendicular to the line of sight when viewed from the center of the room.
4. Borders of grilles shall be suitable for installation surface and materials. Border type shall be surface mount, snap-in, lay-in, spline, or channel frame type as indicated or required for the associated surface. Verify border requirements.

E. Registers:

1. Provide where registers or integral dampers are indicated on the drawings. Same as specified for grilles, except with heavy gauge aluminum opposed blade damper, operable from face of the register.

2.3 GRAVITY VENTILATORS

- A. General: Provide roof-mounted gravity relief ventilators at locations shown on the drawings, size as indicated, each with backdraft damper.
- B. Manufacturers:
 1. Penn Barry "Airette"
 2. Cook
 3. Greenheck
 4. Nailor
- C. Type: Heavy-duty galvanized construction, factory painted, weatherproofed, complete with 1/2" mesh aluminum bird screen. Provide underside of hood with 1-inch thickness, 1-1/2 pound density rigid mineral fiberboard insulation with protective finish.
- D. Roof Curb:

1. Curb will be provided under another section. Secure hood mounting base to roof curb with lag bolts and washers at 12-inch centers.
2. Roof Curb: Provide maximum 24" roof curb, same manufacturer as ventilator hood, complete with curb insulation, metal liner, wood nailer, built-in cant strip. Curb shall be flashed and counterflashed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT AND MATERIALS PROTECTION: Adequately protect equipment and materials against physical damage. Place equipment and materials in first class operating condition, or return to source of supply for repair or replacement, as determined by A/E. Protect all equipment and materials from moisture at all times. Protect during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

3.3 INSTALLATION

- A. Diffuser Connection: Provide a minimum of 12" of straight (vertical) duct above ceiling diffusers or furnish an engineer (prior) approved plenum above diffusers.
- B. Install diffusers, registers, and grilles level and plumb in accordance with the details and notes indicated and the recommendations and printed instructions of the manufacturer for each item.
- C. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- E. Exhaust Grilles in Rooms with Showers: As specified for exhaust grilles in general, except all aluminum construction.
- F. Frames and Borders:
 1. Diffusers and grilles shall have border or margins for tight fit to ceilings for optimum ceiling appearance, designed to cover ceiling openings and minimize dirt development on ceiling. All diffusers and grilles shall be provided with duct rings secured to diffuser or grille outer shell with concealed fasteners.

2. Square Diffusers and Grilles for Exposed "Tee" Grid Ceilings: Square diffusers and grilles that fit well within the framing grid shall be flanged. Where dimension corresponds to the grid dimension, diffuser or grille shall be the same pattern as specified above except margins shall be 5/8" wide with outside dimensions for "lay-in" installation in the standard tee spacing required by the architectural drawings.
- G. Ceiling Grille Orientation: Return and exhaust grilles and registers shall be installed in ceilings such that the blade angle blocks line-of-sight into the duct from the center of the room. If the best orientation still allows the ductwork interior to be seen through the grille from any point in the room that is more than 3 feet from a wall, the visible portion of the interior shall be painted with flat-black paint.
- H. Structural Supports: When very large diffusers are installed, sufficient structural support shall be provided to prevent sagging or distortion of the unit. Provide seismic restraints to prevent diffuser from being dislodged from the ceiling.
- I. Where diffuser and ceiling grille assemblies that weigh more than 15 pounds (and less when required by code), they shall be fully supported independent of a lay-in ceiling grid.

3.4 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing. Set throw direction at all linear diffusers and modular core diffusers. In general, air shall be directed away from adjacent walls, unless indicated otherwise on the drawings. Request engineer direction if proper arrangement is not readily apparent.

3.5 ASHRAE STANDARD 170 CLEANING COMPLIANCE

- A. All supply diffusers in operating rooms (Class B and C surgery), delivery rooms (Caesarean), trauma rooms (crisis or shock), wound intensive care rooms, protected environments (PE), and critical and intensive care rooms shall be opened and cleaned before the space is initially used and at regular intervals thereafter.
- B. Include a statement in the O&M Manuals regarding the requirement for regular cleaning.

3.6 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to startup of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 37 00

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SECTION 23 41 00
PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.3 DEFINITIONS

- A. DOP: Dioctyl phthalate or bis-(2-ethylhexyl) phthalate.
- B. HEPA: High-efficiency particulate air.
- C. ULPA: Ultra low penetration air.
- D. MERV: Minimum Efficiency Reporting Value

1.4 SUBMITTALS

- A. Product Data: Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Shop Drawings: Include plans, elevations, sections, and details to illustrate component assemblies and attachments.
 - 1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
 - 2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air filters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ARI 850.
- D. Comply with ASHRAE 52.1 and ASHRAE 52.2 for method of testing and rating air-filter units.
- E. Comply with NFPA 70 for installing electrical components.
- F. Comply with NFPA 90A and NFPA 90B.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide one complete set of filters for each filter bank. If system includes prefilters, provide only prefilters.
 - 2. Provide one container of red oil for inclined manometer filter gage.

PART 2 - PRODUCTS

2.1 AIR FILTERS

- A. Pleated Panel Air Filters (Pre Filters):
 - 1. Manufacturers:
 - a. Farr Company Type 30/30
 - b. Flanders Airpure
 - c. American Air Filter.
 - 2. General: Provide the air filters, complete with filter cartridges and holding frames. Filter banks shall be field erected, size and arrangement as shown on the drawings. Each filter shall be provided with an identification plate, visibly mounted after construction showing serial number, model number and all other data necessary for ordering renewable media.
 - 3. Filter Media: Non-woven cotton fabric type, reinforced by a woven scrim backing. Synthetic media material (polyester) is not acceptable.
 - 4. Media Support: Media support shall consist of a welded wire grid, effective open area of not less than 96%. Grid shall be bonded to filter media for rigidity.
 - 5. Enclosing Frame: Rigid, heavy-duty beverage board with diagonal support members bonded to the air entering and an exit side of each pleat, to ensure pleat stability. The inside periphery of the enclosing frame shall be bonded to the filter pack so as to eliminate air bypass.
 - 6. Ratings:
 - a. Filter shall be rated MERV 7 per ASHRAE 52.2.

- b. The filter media shall have an average efficiency of 25% to 30% on ASHRAE Test Standard 52.1-92.
 - c. Media shall have an average synthetic dust arrestance of 90-93% in accordance with ASHRAE Test Standard 52.1-92.
 - d. Filters shall be UL Class 2.
7. Effective Filter Media:
- a. 4" Thick: The effective filter media for the 4" thick filters shall be not less than 6.75 sq. ft. of media per 1.0 sq. ft. of filter face area and shall contain 9 pleats per linear foot. Initial resistance at 500 fpm approach velocity shall not exceed 0.18 in. w.g.
- B. High Performance Rigid Type Air Filters (Final Filters):
1. General: Provide the air filters, complete with filter cartridges and holding frames. Filter banks shall be field erected, size and arrangement as shown on the drawings. Each filter shall be provided with an identification plate, visibly mounted after construction showing serial number, model number and all other data necessary for ordering renewable media.
 2. Filter Media: Filters shall be high-density microfine glass fiber media, deep pleated, totally rigid and totally disposable type.
 3. Media Support: Media support shall consist of a welded wire grid with an effective open area of not less than 96%. Grid shall be bonded to filter media for rigidity and shall be designed to support the media both vertically and horizontally.
 4. Filters Contour Stabilizers: Contour stabilizers shall be permanently installed on both the air entering and air exit sides of the filter media pack to ensure that the tapered radial pleat configuration is maintained throughout the life of the filter. The filter shall be capable of withstanding 10 in. w.g. pressure drop without noticeable distortion of the media pack.
 5. Enclosing Frame: Frame enclosing the air filter shall be constructed of galvanized steel, designed so that a rigid and durable enclosure for the filter pack is effected. The filter pack periphery shall be continuously bonded to the inside of the enclosing frame to prevent air bypass. The enclosing frame shall be equipped with protective diagonal supports on both entering and exit side of the filter.
 6. Effective Filter Media:
 - a. Medium Efficiency Filters (60%):
 - 1) Filters shall be rated MERV 11 per ASHRAE 52.2.
 - 2) Filters shall be 60% efficiency per ASHRAE 52.1-92 using atmospheric dust.
 - 3) The initial pressure drop of each medium efficiency clean filter cartridge when operated at 500 fpm shall not exceed 0.28 in. w.g.; final pressure drop shall not exceed 1.5 in. w.g. Filter media area shall be not less than 58 sq. ft.
 - 4) Filter shall be UL Class 2.
 - 5) Manufacturers:
 - a) Farr Company RigaFlo 15
 - b) Flanders Rigid Pak
 - c) American Air Filter
- C. : Holding frames shall be factory fabricated of 16-gauge galvanized steel equipped with gaskets and four heavy-duty positive-sealing fasteners. Each fastener shall be capable of withstanding 25 lbs. pressure without deflection and shall be capable of being attached or removed without the use of tools.
1. Manufacturers:
 - a. Farr Company Type 8
 - b. Flanders

- D. Filter Housings—Side Access Type: Housings shall be factory fabricated and assembled; not less than 16 gauge galvanized steel construction; two access doors of adequate size for filter removal; extruded aluminum tracks and individual universal holding frames designed to accommodate the filters specified herein.
1. Manufacturer:
 - a. Farr Company Model 3P "Universal Glide/Pack"
 - b. Flanders
 - c. American Air Filter.
- E. Filter Differential Pressure Gauges:
1. Inclined Type Draft Gauge: Provide solid acrylic plastic draft gauge across each filter bank with three-way valve on the sensing connections for checking liquid level and filling. Each gauge shall be equipped with two 5' lengths of 1/4" tubing, two static pressure taps, toggle bolt mounting assemblies, and red gauge oil; scale range 0.20-0-3.0 in. w.g.
 - a. Manufacturer: Dwyer "Durablock" Model 200 series AF.
 2. OR Magnehelic Type Gauge: Provide flush mounted differential pressure gauge to measure filter resistance across each filter bank. Gauge shall be the diaphragm-actuated dial type, 4-3/4" O.D. with white dial, black figures and graduations and pointer zero adjustment. Gauges shall include all mounting and connection fittings. Gauges shall be have range 0-2.0 in. wg. in 0.05 minor divisions.
 - a. Manufacturer: Dwyer "Magnehelic" Model 2000 series.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install filter frames according to manufacturer's written instructions.
- B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- C. Install filters in position to prevent passage of unfiltered air.
- D. Install filter gage for each filter bank.
- E. Install filter gage static-pressure tips upstream and downstream from filters to measure pressure drop through filter. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.
- F. Coordinate filter installations with duct and air-handling unit installations.
- G. Electrical wiring and connections are specified in Division 26 Sections.
- H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

- I. Each filter shall be identified in accordance with the identification system indicated on the schedule or drawings with labels complying with Division 23 Section "Identification for HVAC Piping and Equipment". Identification on unit shall be readable from the floor through the primary service access opening.

3.2 Equipment and Materials Protection:

- A. Adequately protect equipment and materials against physical damage. Place equipment and materials in first class operating condition, or return to source of supply for repair or replacement, as determined by A/E. Protect all equipment and materials from moisture at all times. Protect during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components, filter and filter-frame installation, and electrical wiring, and to assist in field testing. Report results in writing in the O&M Manual.
- B. Operate automatic roll filters to demonstrate compliance with requirements. Test for leakage of unfiltered air while system is operating. Correct malfunctioning units then retest to demonstrate compliance. Remove and replace units that cannot be corrected with new units and retest.
- C. HEPA Filters:
 1. Pressurize housing to a minimum of 3.0 in. w.g. (750 Pa) or to designed operating pressure, whichever is higher; and test housing joints, door seals, and sealing edges of filter with soapy water to check for air leaks.
 2. OR Pressurize housing to a minimum of 3.0 in. w.g. (750 Pa) or to designed operating pressure, whichever is higher; and test housing joints, door seals, and sealing edges of filter for air leaks according to ASME N510 pressure-decay method.

3.4 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.
- B. Utilize temporary high-efficiency filters during testing, balancing and commissioning to keep all systems clean. Provide temporary obstructions as needed to simulate dirty filter conditions. A complete set of new filters shall be provided no more than 4 days prior to owner's occupancy of building.

3.5 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.
- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 41 00

SECTION 23 75 00

PACKAGED OUTDOOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
 - 1. Direct-expansion cooling.
 - 2. Electric-heating coils.
 - 3. Gas furnace.
 - 4. Economizer outdoor- and return-air damper section.
 - 5. Integral, space temperature controls.
 - 6. Roof curbs.

- B. Related Sections include the following:
 - 1. Division 23, Section 23 73 33, "Indoor Indirect-Fuel-Fired Heating and Ventilating Units" for outdoor units providing 100 percent tempered outdoor air with heat exchangers.
 - 2. Division 23, Section 23 73 39, "Indoor, Direct Gas-Fired Heating and Ventilating Units" for outdoor units providing 100 percent tempered outdoor air without heat exchangers.
 - 3. Division 23, Section 23 74 33, "Packaged, Outdoor, Heating and Cooling Makeup Air-Conditioners" for outdoor equipment air conditioning 100 percent outdoor air to replace air exhausted from a building.

1.2 DEFINITIONS

- A. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

- B. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

- C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

- D. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

- E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

- F. VVT: Variable-air volume and temperature.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design RTU supports to comply with [wind] [and] [seismic] performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Wind-Restraint Performance:
 - 1. Basic Wind Speed: **85**.
 - 2. Building Classification Category: II.
 - 3. Minimum 10 lb/sq. ft (48.8 kg/sq. m) multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
- C. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to SEI/ASCE 7. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Wiring Diagrams: Power, signal, and control wiring.
- C. Delegated-Design Submittal: For RTU supports 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. Design Calculations: Calculate requirements for selecting vibration isolators [and seismic restraints] and for designing vibration isolation bases.
 - 2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 - 3. Seismic-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
- D. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Manufacturer Seismic Qualification Certification: Submit certification that RTUs, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article and in Division 23, Section 23 05 48, "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Coordination Drawings: Plans 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 RTUs will be attached.
 2. Roof openings
 3. Roof curbs and flashing.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.
- I. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. ARI Compliance:
1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
1. Comply with ASHRAE 15 for refrigeration system safety.
 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 3. Comply with ASHRAE/IESNA 90.1 for minimum efficiency of heating and cooling.
- C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- D. UL Compliance: Comply with UL 1995.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.

4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fan Belts: One set for each belt-driven fan.
 2. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. AAON, Inc.
 2. Addison Products Company.
 3. Carrier Corporation.
 4. Engineered Air.
 5. Lennox Industries Inc.
 6. McQuay International.
 7. Trane; American Standard Companies, Inc.
 8. KEES.
 9. Modine.
 10. Johnson Controls

2.2 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs. Exterior Casing Thickness: 0.0626 inch thick.
- C. Inner Casing Fabrication Requirements: Inside Casing: Galvanized steel, 0.034 inch (0.86 mm) thick.
- D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 1. Materials: ASTM C 1071, Type I.
 2. Thickness: 1/2 inch

3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
 4. Liner Adhesive: Comply with ASTM C 916, Type I.
- E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.
1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
 2. Drain Connections: Threaded nipple both sides of drain pan.
 3. Pan-Top Surface Coating: Corrosion-resistant compound.

2.3 FANS

- A. Direct-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, ECM motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- C. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- D. Relief-Air Fan: Forward curved, shaft mounted on permanently lubricated motor.
- E. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounted frame and RTU-mounted frame are anchored to building structure.
- F. Fan Motor: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.4 COILS

- A. Supply-Air Refrigerant Coil:
1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
 3. Coil Split: Interlaced.
 4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.
- B. Outdoor-Air Refrigerant Coil:
1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

C. Heating Water Coil

1. Comply with ARI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.
4. Seismic Fabrication Requirements: Fabricate coil section, internal mounting frame and attachment to coils, and other coil section components with reinforcement strong enough to withstand seismic forces defined in Division 23, Section 23 05 48, "Vibration and Seismic Controls for HVAC Piping and Equipment" when coil-mounting frame and air-handling-unit mounting frame are anchored to building structure.
5. Heating Coils: Aluminum plate fin and copper tube type with G90 galvanized steel casing; cooling coils enclosed in insulated coil section. Coils shall be continuous 5/8" O.D. tube type, 300-psig proof tested, number of rows and capacity as shown. Fins shall be 0.0075" thickness aluminum plate ripple fin, extended surface rated in accordance with ARI 410 for water or propylene glycol water mixture. The tubes shall have a minimum 0.025" wall thickness of seamless copper expanded into the fin collars to provide a permanent mechanical bond. No metallic or thermal bonding material is acceptable. All coils shall be fully drainable with no trapped tubes. Coils shall be counterflow design with connections either left or right hand as specified or shown. Coils shall be factory tested. Cooling coils shall be ARI certified and labeled.

2.5 REFRIGERANT CIRCUIT COMPONENTS

- A. Number of Refrigerant Circuits: Min. of 2 for RTU-1. Min. of 4 for AHU-7
- B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief and crankcase heater.
- C. Refrigeration Specialties:
1. Refrigerant Charge: R-410A.
 2. Expansion valve with replaceable thermostatic element.
 3. Refrigerant filter/dryer.
 4. Manual-reset high-pressure safety switch.
 5. Automatic-reset low-pressure safety switch.
 6. Minimum off-time relay.
 7. Automatic-reset compressor motor thermal overload.
 8. Brass service valves installed in compressor suction and liquid lines.
 9. Low-ambient kit high-pressure sensor.
 10. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
 11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
 12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.6 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated: Minimum 90 percent arrestance, and MERV 8.

2.7 GAS FURNACE

- A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54. CSA Approval: Designed and certified by and bearing label of CSA.
- B. Burners: Stainless steel with a minimum thermal efficiency of 80 percent.
 - 1. Fuel: Natural gas.
 - 2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.
- C. Heat-Exchanger and Drain Pan: Stainless steel.
- D. Venting: Gravity vented.
- E. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.
- F. Safety Controls:
 - 1. Gas Control Valve: Two stage.
 - 2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 DAMPERS

- A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper filter.
- B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
 - 1. Damper Motor: Modulating with adjustable minimum position.
 - 2. Relief-Air Damper: Gravity actuated with bird screen and hood.

2.9 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.10 CONTROLS

- A. Control equipment and sequence of operation are specified in Division 23 Section 23 09 00, "Instrumentation and Control for HVAC."
- B. Basic Unit Controls:
 - 1. Control-voltage transformer.
 - 2. Wall-mounted thermostat or sensor with the following features:
 - a. Heat-cool-off switch.
 - b. Fan on-auto switch.
 - c. Fan-speed switch.
 - d. Automatic changeover.

- e. Adjustable deadband.
 - f. Concealed set point.
 - g. Concealed indication.
 - h. Degree F indication.
 - i. Unoccupied-period-override push button.
 - j. Data entry and access port to input temperature [and humidity] set points, occupied and unoccupied periods, and output room temperature [and humidity], supply-air temperature, operating mode, and status.
3. Unit-Mounted Annunciator Panel for Each Unit:
- a. Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
 - b. DDC controller or programmable timer and interface with HVAC instrumentation and control system.
 - c. Digital display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.
- C. DDC Controller:
1. Controller shall have volatile-memory backup.
 2. Safety Control Operation:
 - a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
 - b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 degree F enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
 - c. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Division 28, Section 28 31 11, "Fire Detection and Alarm."
 - d. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 degree F .
 - e. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.
 3. Scheduled Operation: Occupied and unoccupied periods on seven day clock with a minimum of two programmable periods per day.
 4. Unoccupied Period:
 - a. Heating Setback: 5 degree F.
 - b. Cooling Setback: System off.
 - c. Override Operation: Two hours.
 5. Supply Fan Operation:
 - a. Occupied Periods: Run fan continuously.
 - b. Unoccupied Periods: Cycle fan to maintain setback temperature.
 6. Refrigerant Circuit Operation:
 - a. Occupied Periods: Cycle or stage compressors to match compressor output to cooling load to maintain discharge temperature. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
 - b. Unoccupied Periods: Cycle compressors and condenser fans for heating to maintain setback temperature.
 - c. Switch reversing valve for heating or cooling mode on air-to-air heat pump.
 7. Gas Furnace Operation:

- a. Occupied Periods: Stage burner to maintain room temperature.
 - b. Unoccupied Periods: Cycle burner to maintain setback temperature.
8. Fixed Minimum Outdoor-Air Damper Operation:
- a. Occupied Periods: Open to 15 percent.
 - b. Unoccupied Periods: Close the outdoor-air damper.
9. Economizer Outdoor-Air Damper Operation:
- a. Occupied Periods: Open to 25 percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 75°F. Use outdoor-air temperature to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
 - b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
 - c. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature, and output shall range from 2- to 10-V dc.
10. Carbon Dioxide Sensor Operation:
- a. Occupied Periods: Reset minimum outdoor-air ratio down to minimum percent to maintain maximum 1000-ppm concentration.
 - b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
11. VVT Relays:
- a. Provide heating- and cooling-mode changeover relays compatible with VVT terminal control system required in Division 23, Sections 23 36 00, "Air Terminal Units" and "Instrumentation and Control for HVAC."
- D. Interface Requirements for HVAC Instrumentation and Control System:
1. Interface relay for scheduled operation.
 2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
 3. Provide LonWorks compatible interface for central HVAC control workstation for the following:
 - a. Adjusting set points.
 - b. Monitoring supply fan start, stop, and operation.
 - c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature.
 - d. Monitoring occupied and unoccupied operations.
 - e. Monitoring constant and variable motor loads.
 - f. Monitoring variable-frequency drive operation.
 - g. Monitoring cooling load.
 - h. Monitoring economizer cycles.
 - i. Monitoring air-distribution static pressure and ventilation air volume.
- 2.11 ACCESSORIES
- A. Electric heater with integral thermostat maintains minimum 50 degree F (10 degree C) temperature in gas burner compartment.
 - B. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required.

- C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- D. Coil guards of painted, galvanized-steel wire.
- E. Hail guards of galvanized steel, painted to match casing.
- F. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

2.12 ROOF CURBS

- A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Division 23, Section 23 05 48, "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: ASTM C 1071, Type I or II.
 - 2. Thickness: **1 inch (25 mm)**
 - 3. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - d. Liner Adhesive: Comply with ASTM C 916, Type I.
- C. Curb Height: Max. **24 inches** .
- D. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements in Division 23, Section 23 05 48, "Vibration and Seismic Controls for HVAC Piping and Equipment" for wind-load requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07, Section 07 72 00, "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- B. Unit Support: Install unit level on structural **curbs**. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.
- C. Install wind and seismic restraints according to manufacturer's written instructions. Wind and seismically restrained vibration isolation roof-curb rails are specified in Division 23, Section 230548, "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- B. Install piping adjacent to RTUs to allow service and maintenance.
 - 1. Gas Piping: Comply with applicable requirements in Division 23, Section 23 11 23, "**Facility Natural-Gas Piping**". Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination at top of roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Connect supply ducts to RTUs with flexible duct connectors specified in Division 23 Section 23 33 00, "Air Duct Accessories."
 - 4. Install return-air duct continuously through roof structure.
 - 5. Install normal-weight, 3000-psi (20.7-MPa), compressive strength (28-day) concrete mix inside roof curb, **4 inches** thick. Concrete, formwork, and reinforcement are specified in Division 03.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
- C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
 - a. Measure gas pressure on manifold.
 - b. Inspect operation of power vents.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.

23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 degree F (8 degree C) above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
 - c. Filter high-pressure differential alarm.
 - d. Economizer to minimum outdoor-air changeover.
 - e. Relief-air fan operation.
 - f. Smoke and firestat alarms.
29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Division 01, Section 01 79 00, "Demonstration and Training."

3.8 COMMISSIONING

- A. Notify the Commissioning Agent one week prior to start up of equipment.

- B. Submit to the Commissioning Agent a Verification of Completion form with the pre-functional check off sheet for each component when it is ready for functional testing.
- C. Assist the Commissioning Agent as required to perform the functional testing on the system components and the system as a whole.

END OF SECTION 23 75 00

SECTION 26 05 00

COMMON WORK RESULTS

PART 1 - GENERAL

1.1 OUTLINE OF WORK

- A. Scope: The work under this division includes furnishing all materials, equipment, labor, supervision, tools and items necessary for the construction, installation, connection, testing and operation of all electrical work for this project as shown on the Electrical Drawings and/or defined in Division 26 of the specifications.
- B. Contract Requirements: Comply with the requirements of the General Conditions, the Supplementary Conditions, and Division 01 as they apply to the work in this section. Comply with the requirements of the other specification divisions that have additional requirements for this work as referenced under Division 26 sections.
- C. Related Work Described Elsewhere: Where other divisions require electrical materials or installations under this division of the specifications, comply with all applicable requirements herein. Provide all electrical materials and installation work required to connect, test and operate equipment described in other divisions of these specifications as shown on the Electrical Drawings or specified hereinafter. Electrical installations required by other divisions but not shown on the Electrical Drawings or specifically called out in this division of the specifications shall be provided by the trade requiring the electrical work.
- D. Itemized Schedule of Costs: Furnish a contract cost breakdown by specification section to the Architect with a copy to the Engineer to allow evaluation of partial payment requests. Refer to Division 01 for requirements.
- E. Warranty: The Contractor shall guarantee all work installed under this specification and make good, repair or replace at his own expense, any defective work, materials or parts within the warranty period, if, in the opinion of the Architect, said defect is due to imperfection in material, design or workmanship. The warranty period shall be in accordance with Division 01 but not less than one year. Lamps are not warranted but all shall be operating at time of final acceptance. Warranty shall be submitted in writing as required in Division 01.

1.2 REGULATIONS

- A. Codes and Ordinances: Comply with all applicable codes, ordinances and regulations including the National Electrical Code, the Washington Administrative Code, National Electrical Safety Code, WISHA, NFPA, and all other national, state and local codes and ordinances. Notify the Architect of any non-compliance in contract documents to applicable codes and regulations prior to installation of the work. Changes in the work after initial installation due to requirements of code enforcing agencies shall be at no additional cost to the Owner.
- B. Permits: Provide and pay for all permits and fees required for this project. In addition to paying for all permits and fees, the Contractor shall be responsible for contacting the various Approving Authorities, arranging for review of shop drawings where appropriate, scheduling inspections in a timely manner, and making necessary corrections as required by the Approving Authorities.

- C. Approving Authority: It is the Contractor's responsibility to ascertain and contact the appropriate "Approving Authorities" for this project. Approving Authorities will include, but not be limited to the local Fire Marshal and the local authority having jurisdiction.
- D. Certificate of Inspection: Obtain a Certificate of Electrical Inspection from the local inspecting authority indicating final acceptance. Submit to the Owner upon completion of the project as part of project closeout.
- E. Safety Measures to be Taken: The Architect and Engineer have not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the Contractor to perform his work. The Contractor will be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The duty of the Architect and Engineer to conduct construction observations of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures, in, on or near the construction site. It shall be the Contractor's responsibility to comply with "Safety and Health Regulations for Construction," Volume 36, No. 75, Part II of the Federal Register by the U.S. Department of Labor. Contractor shall be responsible for providing all such safety measures and shall consult with the state or federal safety inspector for interpretation whenever in doubt as to whether safe conditions do or do not exist or whether he is or is not in compliance all with state or federal regulations.

1.3 DRAWINGS AND SPECIFICATIONS

- A. Intent: The Electrical Drawings and specifications are intended to include all labor and materials necessary to provide a complete and operating facility. Any materials shown and called for on the drawings but not mentioned in the specifications, or vice versa, which are necessary for the proper completion of the installation or operation of the equipment, shall be furnished the same as if specifically called for in both. By submitting a bid, the Contractor is acknowledging that he has made a thorough examination of the contract documents, existing site conditions, and has determined that these documents and conditions do sufficiently describe the scope of construction work required under this contract. Any questions regarding interpretation of the contract documents shall be made in writing in a timely manner prior to the bid date to allow reasonable time for resolution of the questions.
- B. Diagrammatic Drawings: The Electrical Drawings are diagrammatic and do not show exact or complete raceway and wiring configurations, routing, rating or the necessary number and types of raceway fittings, junction boxes and pull boxes. Provide all labor and materials required to execute the work specified herein or described on the Electrical Drawings.
- C. Any minor changes (less than 6'-6" horizontal or vertical) in the location of the raceways, outlets, boxes, devices, wiring, etc., from those shown on the drawings shall be made without extra charge, where coordination requires or if so directed by the Architect prior to rough-in.

1.4 SUBMITTALS AND SHOP DRAWINGS

- A. Submittals, General: All equipment must be submitted for review prior to installation. Provide submittals in accordance with Division 01. The remaining instructions in this paragraph are intended to supplement and amplify the requirements of Division 01. Bind submittals in three-ring binder. Open catalog sheets will not be accepted. Shop drawings shall consist of one reproducible drawing and a maximum of four blueprint sets. Index to the applicable specification section with a transmittal letter bound as the first sheet. Provide an index with each section of equipment indicating exact catalog numbers of products provided. In addition, identify the specific products by catalog number within the submittal documents. Submittals will not be accepted unless they conform to these requirements.
- B. Shop Drawings: Provide shop drawings, descriptive bulletins, data sheets, diagrams, catalog cuts or other additional information as required for all specified materials including the following:

Submittal	Date	Number	Reviewed
Raceways and Fittings		_____	_____
Cable Tray		_____	_____
600-Volt Wire and Cable		_____	_____
Outlet, Junction and Pullboxes		_____	_____
Wiring Devices		_____	_____
Electrical Identification		_____	_____
Exterior Lighting Control		_____	_____
Motor Controls & Misc. Equipment Connections		_____	_____
Emergency Generator		_____	_____
Switchboards		_____	_____
Disconnect Switches		_____	_____
Fuses		_____	_____
Grounding		_____	_____
Panelboards		_____	_____
Transient Voltage Surge Suppressors		_____	_____
Automatic Transfer Switch		_____	_____
Lighting		_____	_____
Dry-type transformers		_____	_____
Daylight Harvesting and Dimming System		_____	_____
Fire Alarm System		_____	_____
Intercom and Master Clock System		_____	_____
Clock System		_____	_____
Telecommunications System		_____	_____
Sound Reinforcement System		_____	_____
CATV System		_____	_____

- C. Submittal Format: Submittals must be sent in complete "sets," including all specified material. Submission of individual materials will not be accepted.
- D. Review: The review of a manufacturer's name or product by the Architect does not relieve the Contractor of the responsibility for providing materials and equipment which comply in all details with the requirements of the contract documents. Contractor shall be solely responsible for submitting materials at such a time to allow a minimum of two weeks for Engineer's review.

- E. It is the Contractor's responsibility to thoroughly review vendor-assembled shop drawings, catalog cuts, etc. to ensure that these documents are complete and comply with the specifications. If this coordination effort is not done, the Architect reserves the right to reject the complete submittal without review. To insure compliance with the Architect's review comments and communication of these comments through the Contractor and supplier to the manufacturer, all corrections to shop drawings shall be done by the manufacturer and resubmitted as requested by the Architect. "Local" mark-ups of the manufacturer's shop drawings will not be accepted.

1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide operations and maintenance manuals for all electrical equipment installed on this project in accordance with Division 01.
- B. Items described shall include, but not be limited to, the equipment listed under "Shop Drawings" in this division of the specifications. Provide table of contents at front of manual indicating general content of each section. Provide index for each section of the manual with complete equipment catalog item or identification.
- C. The information and diagrams included must be on the specific equipment installed for this project. General "product line" information is not acceptable. The equipment model and catalog numbers with appropriate prefixes and suffixes must be clearly indicated on the data sheets. Manuals shall contain shop drawings, schematic and wiring diagrams (showing all external connections), parts lists, operating and maintenance information. Any modifications to equipment in the field shall be updated on the drawings, diagrams, etc., to reflect the "as-built" conditions.
- D. Binding: Bind with three-screw post-type binder with heavy-duty hardboard cover and cloth backing. Imprint edge of volume with name of the building, year of completion and the words "Electrical Equipment." Front of manual shall be imprinted with the words "Electrical Equipment" the name of the project, the name of the Owner, year completed, name of the Architect, Engineer and Contractor. All printing in gold lettering. If the thickness of the manual exceeds approximately 2", provide separate volumes, each approximately 2" thick with each volume imprinted as described above and with the addition of the volume number. The back edge shall be imprinted with the name of the project, name of the Owner and year of completion.
- E. Provide one preliminary copy to the Commissioning Authority for review 30 days prior to scheduled training or project completion, whichever is first. One preliminary copy shall be submitted to the Engineer for review 30 days prior to completion of the project. Placeholders are to be used for information that is not available at the time of draft manual submission. Preliminary copy shall include proposed wording for cover and back edge of the manual. Submit final bound copies for distribution as required by Division 01.

1.6 RECORD DRAWINGS

- A. Maintained on Site: A record shall be made during the progress of the project indicating the work as actually installed. Corrections and changes shall be kept up to date at all times on a separate set of record drawings kept at the job site for review by the Architect. Mark-ups may be schematic as related to interior raceway systems, however, all raceways shall be shown in proper relationship with junction boxes, panelboards, devices, and equipment. Raceways installed below grade shall be shown with both horizontal and vertical dimensions at an accuracy of ± 6 inches.

- B. Project Closeout: Provide one set of prints indicating work as revised, detailed and actually installed, and submit to the Architect as part of the Project Closeout documentation. Panel schedules and fixture/equipment schedules shall also be updated.
- C. Additional Record Drawings: Refer to Signal and Communication Systems section for additional record drawing requirements. AutoCAD production requirements also apply to all signal and communications system drawings.

1.7 CONSTRUCTION SCHEDULING AND SEQUENCING

- A. Construction will occur in numerous phases. At the completion of each phase the electrical systems shall be tested and the Owner trained in the use of the systems. Refer to Architectural Drawings and the specifications for construction schedules and sequencing requirements.

1.8 ABBREVIATIONS AND DEFINITIONS

- A. Provide: To furnish and install.
- B. Wiring: Raceway, conductors and connections.
- C. Exposed: Visible from occupied areas.
- D. Install: To set in position and make fully operational.
- E. Furnish: Purchase and deliver to the job site.
- F. Required: As required by code, authority having jurisdiction or contract documents for the system and/or installation to be fully operational.

PART 2 - PRODUCTS

2.1 STANDARD OF QUALITY

- A. General: Whenever any material or equipment is specified by patent or proprietary name or by the name of the manufacturer, such specification shall establish the standard of quality in that particular field of manufacture. The Architect shall be the sole and final judge as to quality and acceptability of substitutions, no exceptions.
- B. Substitutions:
 - 1. Unless otherwise noted on the drawings or other sections of the specifications, the Contractor may offer material or equipment with equal or better qualities than those specified. Reference is made particularly to Instructions to Bidders related to prior approval requirements.
 - 2. When the substitute equipment or material necessitates revisions to the plans or involves other trades, the Contractor shall include drawings and details showing all such changes, and coordinate and assume any liability and costs from the affected trades. Also, if a change required engineering or mechanical services or other equipment modifications, these services shall be billable to the Contractor.

2.2 PRODUCT LISTING OR LABELING

- A. All electrical equipment and materials shall have Underwriters' Laboratories, Inc., or other approved testing facility label whenever published standards exist. Equipment in compliance with UL standards but not bearing their label is not acceptable. If the manufacturer cannot arrange for labeling of an assembled unit at the factory, the necessary inspection and acceptance by the testing facility shall be performed in the field at no additional cost to the Owner, and be acceptable to the authority having jurisdiction.

PART 3 - EXECUTION

3.1 GENERAL

- A. All materials shall be new, free from defects and arrive at the job site in original unopened containers.

3.2 MATERIAL STORAGE

- A. Make all necessary provisions for storing materials and equipment at site so as to insure the quality and fitness of the items to be incorporated in the work. Equipment shall be stored to prevent damage and corrosion.

3.3 WORKMANSHIP AND COORDINATION

- A. General: Workmanship shall be the best quality as recognized by the electrical construction industry and satisfactory to the Owner and Architect. Remove and replace lesser quality work as directed at no additional cost to the Owner. The Architect, or his designated representative, shall be the judge of the required quality of workmanship.
- B. Work of Other Trades: The Electrical Drawings do not show complete details of the building construction. Refer to the Architectural, Structural, Civil Landscape and Mechanical Drawings for those details which may affect the execution of this work. Specific locations of construction features shall be obtained from the reference drawings, field measurements, or the trade providing the material or equipment. No extra payments will be allowed for failure to obtain this information.
- C. The Contractor will not be paid for work requiring reinstallation due to lack of coordination prior to installation i.e., removing, replacing, relocating, cutting, patching or finishing. Special attention is called to the following items and all conflicts shall be coordinated prior to installation:
 - 1. Light switches will be located on the "strike" side of the door.
 - 2. All electrical outlets, lighting fixtures, signal and communications devices, and other electrical devices and equipment are installed to avoid conflict with grilles, pipes, sprinkler heads, ducts and other mechanical equipment.
 - 3. Electrical outlets, lighting fixtures, signal and communications devices and equipment are to be installed in proper relation to cabinets, counters, doors and other Architectural appurtenances.
 - 4. Electrical characteristics (HP, KVA, voltage, phase, fusing, overload protection) of actual equipment furnished under other divisions being different from that shown on the electrical drawings.

- D. Cooperation: Plan and execute work in cooperation with all other trades and utility companies. Every reasonable effort shall be made to provide all concerned with timely notice of work affecting other trades, and to prevent conflicts or interference as to space requirements, dimensions, openings, block-outs, sleeving or other matters which will cause delays or necessitate work-around methods.
- E. General Construction:
1. Cutting and Patching: Provide all cutting, demolition and patching required for the installation of the electrical work on this project. Patching shall be accomplished by utilizing the general construction trades normally providing materials and labor needed for restoration of floor, ceiling or walls. Penetrations through existing structural walls, ceiling or floor slabs shall be core drilled. Spillage from core drilling shall be contained by diking, vacuuming and covering with protective plastic sheeting as required. In no case shall structural members be penetrated without prior approval of the Architect. After installation of raceways, provide approved fire sealing materials to close spaces around raceways.
 2. Sleeves and openings required through floors and walls for electrical work shall be the responsibility of the Contractor. This work shall be carefully coordinated with the General Contractor and other trades involved. All openings around conduits in sleeves shall be sealed with a material of equal fire rating as the material penetrated.
 3. Painting: Touch up electrical equipment with factory finished surfaces as required using factory furnished paint. Coordinate field painting requirements with the Architect prior to final trim and cover installation. Do not paint screw heads, hinges, nameplates, hardware, etc. All surface-mounted raceways in finished areas will be painted as directed under the "Painting" division of the specifications. Coordinate timing of installation to minimize conflicts with painting requirements.
 4. Cleaning: Promptly remove waste material and rubbish resulting from electrical work. Prior to energizing equipment, remove all chipping materials, construction dirt and debris, vacuum and wipe-down all internal areas. At completion of the project, clean all equipment and fixtures installed under this Contract.
 5. All penetrations through building roofing shall be flashed by a qualified roofing contractor normally in the business of commercial roofing. Flashing shall be in accordance with NRCA standard practices.
 6. No penetrations shall occur in beams with internal pre-stressed cable design or concrete floor slabs with pre-stressed cabling will be allowed without prior written analysis by a structural engineer.
 7. Prevent spillage during hauling operations. In cas of spills (including trenching materials) clean streets, walkways, courtyards, etc. by means of proper sweepers or other approved methods.
 8. School dumpsters shall not be used by the contractor.
- F. Existing Conditions:
1. General: Specific scope of demolition work and operating conditions to be encountered shall be verified by on-site review prior to submitting bid. Demolition work in general is noted or shown on the documents based upon available "drawings of record" and may not show the actual conditions as they presently exist. The Contractor shall be responsible for removing or modifying the existing electrical installation as required by the building alterations. The Contractor shall be responsible for protection of existing equipment and wiring to be retained or reinstalled and shall replace any equipment damaged during the process of removal and reinstallation.

2. Owner Retained Equipment: The Owner may wish to retain certain specific items scheduled for demolition. The Contractor shall carefully remove these items, provide protection and packaging as may be required to protect the equipment and turn over said equipment to the Owner at a place designated on the jobsite. Any equipment that the Owner does not desire to retain shall become the property of the Contractor and be removed from the site.
3. Existing Conduit and Wiring: No existing conduit or wiring shall be reused.
4. Unused Conduit and Wiring: All unused conductors in existing buildings shall be removed. All unused conduit shall be removed except where located in or above existing construction which is not being altered and would require removal and replacement of the existing construction.

G. Continuity of Service To and In Existing Building:

1. Continuity of Service: The Contractor shall temporarily reroute or relocate existing wiring and/or equipment which is in conflict with existing building alterations and which is required to be maintained in use during construction. The Contractor's bid shall include intercepting and relocating existing raceways in 20 different locations throughout the school. Each location shall be assumed to have four ¾" EMT raceways (100 L.F. each), each containing seven AWG conductors which must be intercepted and relocated.
2. Premium Pay: Any overtime work required by this project to maintain the facility in continuous service without reducing its efficiency shall be included as a part of this contract. No additional payments will be authorized for work performed on weekends, holidays or other-than-normal working hours.

3.4 REMOVAL AND REPLACEMENT OF EXISTING MATERIAL:

- A. Ceiling Panels: Remove and reinstall all necessary panels in existing accessible ceilings, as required for the installation of electrical work. Where existing ceiling panels are damaged, they shall be replaced with new units. After ceiling removal and reinstallation is complete, the ceiling system appearance shall match adjacent similar ceilings that have not been removed.
- B. Work Caused by Removal and Reinstallation of Existing Material: Existing electrical work which is to be removed and reinstalled as a result of the installation of work by other trades shall be performed by the Electrical Contractor at no additional expense to the Owner.
- C. Existing fluorescent fixture ballasts to be removed may contain PCB's and are to be treated as hazard materials. Removal and disposal of these fixtures are to comply with all local, state, and federal agency requirements. Provide documentation as required by the regulating agency as proof of proper disposal.
- D. Openings in walls and floors resulting from removal of conduits and/or devices are to be patched with materials equivalent to adjacent surfaces. Materials used for patching shall maintain the fire rating of the existing area.

3.5 MISCELLANEOUS

- A. Equipment Anchorage, Support and Bracing:
 1. General: Provide complete seismic anchorage and bracing for the lateral and vertical support of conduit and electrical equipment, as required by the Uniform Building Code.

2. Conduit Crossing Structural Separations: Conduit that crosses structural or seismic separations between building units shall be installed with flexible connections, suitable to accommodate longitudinal and transverse displacements. Secure raceways each side of joint and provide minimum of 36" length flexible conduit between building units.
- B. Phase Relationship: Maintain consistent phase relationship and rotation throughout the project. Check and identify proper rotation of equipment prior to energizing said equipment.
- C. Housekeeping Pads: Coordinate size and location of housekeeping pads for all floor-mounted electrical equipment. Pads shall be 4 inches thick (nominal) x 2 inches larger than plan view dimensions of equipment. Provide 1-inch x 1-inch chamfer at top edges of pads.

3.6 CONSTRUCTION OBSERVATION AND FINAL ACCEPTANCE

- A. Site Review: On-site meetings or reviews of construction by the Architect, Engineer or Owner shall not be construed as acceptance by these parties as related to quantities, rough-in locations, and compliance with code enforcing authorities unless specific exceptions have been brought to the attention of the Architect or Engineer and have been accepted in writing.
- B. Testing: The Contractor shall test all wiring and all electrical equipment to verify absence of grounds and short circuits and verify proper operation, rotation, and phase relationship. Contractor will be responsible for scheduling of tests and demonstrations at times mutually acceptable to the Owner. All equipment shall be demonstrated to operate in accordance with the requirements of this specification and the manufacturer's recommendations. Operate every device manually and automatically in accordance with its purpose. Tests shall be performed in the presence of the Owner or his designated representative. All instruments and personnel required to conduct the test shall be provided by the Contractor. Any test not witnessed by the Owner shall be waived by written document. All such documents must become the property of the Owner upon completion of construction.
- C. Commissioning:
 1. Selected equipment and systems are to be commissioned per Section 01 91 00 – General Commissioning Requirements and Section 26 08 00 – Commissioning for Electrical Systems. The contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.
 2. Provide copies of all start up documents for systems being commissioned to the Commissioning Authority prior to start of commissioning testing.
 3. Provide assistance to the Mechanical Contractor and Commissioning Agent as specified in Section 01 91 00 and 26 08 00.
- D. Instruction for Owner's Personnel:
 1. Scope: Following initial operation of all electrical equipment and prior to acceptance of the electrical work, conduct demonstrations of equipment operation and instruction periods for the Owner's representatives.
 2. Initial Instruction Periods: Shall include preliminary discussion and presentation of information from maintenance manuals with appropriate references to drawings, followed by tours of equipment spaces explaining maintenance requirements, access methods, servicing and maintenance procedures, settings and available system and equipment adjustments.

3. Final Instruction Periods: 30 days after the initial instruction, a second instruction period shall be scheduled. The format and duration of the instruction periods shall be identical to the initial instruction periods.
4. Contractor's representatives, in general, who conduct these instructions and demonstrations shall be qualified foremen or superintendents acquainted with this project and from the trade involved. For major equipment, the representative shall be the manufacturer's representatives with operating experience and substantial design experience on this project. Their qualifications shall be submitted to the Architect and Engineer before conducting the instruction period.
5. Minimum Duration of Instruction Periods:
 - a. Electrical Distribution System: 4 Hours
 - b. Lighting System: 4 hours
 - c. Signal and Communications Systems: 4 Hours each
 - d. Refer to other section of the specification for additional testing requirements.
6. Scheduling of Instruction Periods: Provide notice of Contractor's readiness to conduct such instruction and demonstration periods to the Owner at least two weeks prior to each instruction period and reach agreement on the date of each instruction period.
7. Attendance sheets shall be filled out for each training session listing all participants. Copies of the attendance sheets shall be provided to the Commissioning Authority.
8. Prepare a written statement of acceptance for the Owner's signature. The statement shall be substantially as follows:
 "I (the Contractor), the associated factory representatives and the subcontractor, have thoroughly tested each of the following systems and have proved their normal operation to the Owner's representative and have instructed him in the operation and maintenance thereof."

<u>Owner's System</u>	<u>Demonstrator</u>	<u>Representative</u>	<u>Date</u>
Electrical Distribution	_____	_____	_____
Lighting	_____	_____	_____
Emergency Generator	_____	_____	_____
Fire Alarm	_____	_____	_____
Intercom & Clock Systems	_____	_____	_____
Gym/Commons Sound System	_____	_____	_____
Telecommunications	_____	_____	_____
CATV Systems	_____	_____	_____

		Owner's	
Representatives	Date	_____	_____
_____	_____	Contractor	_____
Date	_____		

9. Send copies of this acceptance to the Architect and the Engineer and place one copy in each maintenance manual.
- E. Completion of Work: When requesting final inspection, provide ten day notice. Submit written certifications that the work has been fully completed in strict accordance with the plans and specifications.
 - F. Final Documentation: See specifications Section 01 70 00, "Execution and Closeout Requirements." All manuals, test results, and acceptances by the inspecting authorities shall be included in this final documentation.

3.7 FINAL ACCEPTANCE

- A. The Electrical Contractor shall submit to the Architect a Project Closeout Form (form at end of this section) properly filled out prior to the time final acceptance of the electrical work is requested. At this time also submit copies of final inspection certificates and receipts for loose materials (spare wiring devices, fuses, etc.) turned over to the Owner.

JOB CLOSEOUT FORM

1. Electrical Inspector's Final Acceptance:

- Copy of certificate attached.
- Transmitted previously to _____

Date

2. Fire Marshall's Final Acceptance of Fire Alarm System:

- Copy of certificate attached.
- Transmitted previously to _____

Date

3. As-Built Drawings: Enclosed

Transmitted previously to _____

Date

4. O & M Manuals: Enclosed

Transmitted previously to _____

Date

5. Telecommunications System Test Reports:

Enclosed
 Transmitted previously to _____

Date

6. Telecommunications System Test Reports:

Enclosed
 Transmitted previously to _____

Date

7. Spare Parts: Delivered to _____
Date

Note: Provide separate letter of transmittal with itemized list of parts for each set of spare parts.
Transmittal must be signed by an authorized representative of the Owner.

8. As-Built Fire Alarm Shop Drawings:

Enclosed
 Transmitted previously to _____

Date

9. As-Built Intercom/Clock and Sound System Shop Drawings: Enclosed

Enclosed
 Transmitted previously to _____

Date

10. As-Built Gym/Commons/Music Room System Shop Drawings:

Enclosed
 Transmitted previously to _____

11. As-Built Telecommunications Shop Drawings:

Enclosed
 Transmitted previously to _____
Date

12. As-Built Security Shop Drawings: Enclosed

Transmitted previously to _____
Date

13. As-Built CATV Shop Drawings: Enclosed

Transmitted previously to _____
Date

14. Testing and Owner Training: Copy of written certification attached.

Transmitted previously to _____
Date

15. The work is complete in accordance with the contract documents and authorized changes except for the following (attach a separate sheet if necessary):

Electrical Contractor _____ Date

General Contractor _____ Date

END OF SECTION 26 05 00

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SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all wire and cable required for electrical systems being installed.

PART 2 - PRODUCTS

2.1 PROHIBITED MATERIALS:

- A. Type MC cable, similar to Armor Cable and like material.

2.2 MATERIALS

- A. All wiring shall be Copper and be rated at 600 volts. Aluminum is acceptable for feeders rated 100 amps or larger.
- B. Wire sizes 12 and 10 shall be solid, Type THHN, Wire sizes 8 and larger shall be stranded, type THW, THHN/THWN. Minimum wire size shall be 12 AWG, unless noted otherwise.
- C. Pre-manufactured fixture whips may be used to connect recessed light fixtures in accessible ceilings.
- D. Minimum Conductor Size:
 - 1. Neutral: #10 AWG (#12 AWG minimum for dedicated neutrals and lighting circuits).
 - 2. Ground: #12 AWG.
- E. Molded connectors with metal thread-on core shall be used for splicing 12 and 10 wire.
- F. Stranded cable shall be connected to lugs using mechanical connectors and shall be wrapped with electrical tape to a thickness equal to the wire insulation connecting block.
- G. Splices: For #8 and larger conductors, use molded insulated connector splice block.

2.3 MANUFACTURER

- A. American Insulated Wire Corp, General Cable, Rome, Southwire, or approved equal.

2.4 TERMINATIONS AND SPLICES

- A. Provide insulated screw-on type connectors on lighting and receptacle branch circuit splices; Ideal Wingnut or equal. Self-stripping crimp-pressure-type connectors such as Scotchlock 500 series are not approved. Insulated ring-tongue compression-type terminals (Burndy or T&B) for motor and equipment terminations; hydraulically set compression lugs for terminations at panel and switchboard busses; and Cadweld exothermic type for grounding systems.
- B. Below-grade splices shall be made in handholes and shall be made watertight with epoxy resin type splicing kits. Scotchcast or equal.

2.5 SIGNAL AND COMMUNICATIONS WIRING

- A. All signal and communications wiring is included in the appropriate signal and communications system specification sections.

2.6 CABLE TIES

- A. Shall be Thomas & Betts "Ty-Rap." Provide in switchboards, wireways, panelboards, relay panels and other enclosures to neatly group and lace electrical conductors.

2.7 WIRE PULLING COMPOUND

- A. Manufacturer: Ideal "Aqua-Gel II" or equal.

PART 3 - EXECUTION

3.1 BRANCH CIRCUITS

- A. Branch circuits shall be no. 12 AWG minimum, color-coded as listed below. Homeruns greater than 100 feet to first outlet shall be No. 10 minimum. Use no mechanical means for pulling wire. Make no splices in home runs. Wiring from separate raceway systems shall not be intermixed in common junction boxes. Wiring shown in separate raceway systems shall not be combined unless specifically approved by the engineer.
- B. All circuits shall have separate neutrals. No shared neutrals will be allowed.
- C. Provide separate ground bonding conductor full length inside all conduit.
- D. Where more than three current carrying conductor are installed in a single raceway, the minimum wire size shall be increased to comply with NEC 310-16, Note 8.

3.2 FEEDERS

- A. Feeders shall be sized as shown on the drawings and color-coded in accordance with list below. Make no splices unless shown on the plans or specifically approved by the Architect's representative.

Phone:	Green
Cash:	Yellow
EMS:	White
High speed data to hub:	Red
Wireless device:	Black

- E. Color coding shall be approved by the inspecting authority.

3.4 SPLICES AND TERMINATIONS

- A. Lighting and receptacle branch circuit conductors up to No. 10 AWG shall be spliced with wing nut type connectors. Motor connections using wiring No. 8 AWG and larger shall be made with crimp-type sleeves or lugs insulated with heat shrink tubing. Feeders shall not be spliced, except in special situations after engineer approval.

3.5 PHASE BALANCING

- A. Contractor shall check load on each phase at each panel and service equipment, and make the necessary circuit adjustment to ensure proper balance of load on all three phases.

3.6 HOME RUNS

- A. Branch circuit conductors shall be home run to panelboards as shown on the drawings. Combining branch circuit home run conductors in single conduits is allowed up to three current carrying conductors per conduit.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 GENERAL

- A. Provide power grounding system and equipment grounding system in accordance with the applicable codes and ordinances and as further defined on the plans.

1.2 GROUND CONTINUITY

- A. Provide through the entire electrical system. A separate green equipment grounding conductor shall be provided in all branch circuits.

1.3 BONDING

- A. Insulated grounding bushings shall be installed to bond all feeder conduits to the switchboard ground bus or panel ground bus at both ends of feeder raceways. Insulated grounding bushings shall also be installed in all feeder pull boxes to bond all conduits together. Jumpers or bonds shall be copper and sized in accordance with Table 250-95 of the National Electrical Code.

1.4 NEUTRAL GROUNDING

- A. The neutral point of all radically operated transformers shall be solidly grounded to the grounding system and transformer enclosure with code size ground conductors. The neutral bus in each panelboard shall be isolated from ground. The neutral shall be grounded only at a single point at the main switchboard or at separately derived system transformers.

1.5 SIZE OF GROUND WIRE

- A. In all cases, shall not be less than that required under National Electrical Code requirements.

1.6 RECEPTACLE GROUNDING

- A. Connect the ground terminal of all receptacles by utilizing a separate grounding conductor between the receptacle grounding screw and the ground conductor provided in the branch circuit. Integral mounting straps within the receptacle connected to the device mounting straps are not approved as a grounding method.

1.7 FLEXIBLE CONDUIT GROUNDING

- A. Provide a separate grounding conductor in all flexible conduit runs including watertight flexible conduit with integral grounding straps. Install ground conductor inside conduit with ungrounded conductors.

1.8 PVC CONDUIT GROUNDING

- A. Provide a code size green grounding conductor the full length of the feeder or branch circuit when PVC is used in whole or in part.

1.9 GROUND CONNECTIONS

- A. Ground connections to building steel, ground rods and cable taps shall utilize an exothermic welding process.

PART 2 - PRODUCTS

2.1 GROUND CONDUCTORS:

- A. Copper conductors in accordance with Section 26 05 26.

2.2 EXOTHERMIC CONNECTIONS

- A. "Cadweld Exolon," Erico Products, Inc., Burndy "Thermoweld" or approved equal.

2.3 INSULATED GROUND BUSHINGS

- A. Malleable iron with insulated ring and ground clamp. Steel City or equal.

2.4 COMPRESSION CONNECTIONS

- A. Non reversible comperssions – listed hydraulically-crimped fittings

2.5 GROUND RODS

- A. 3/4" x 10'-0" long. Copper clad steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide main grounding busbar for telephone/data, intercom, television system head end equipment. Grounding conductor for telephone/data, intercom, television system main grounding busbar shall be #6 AWG, 600 volt, insulated copper conductor.
- B. Bond all telecommunication equipment chassis, ladder racks, cable trays, conduits, equipment frames, cabinets, and all other telecommunications room and equipment room metallic components to the main grounding busbar.
- C. Install ground rod vertically, with top flush with ground level unless physically protected. Connect to water service on street side of main shutoff valve, building structural steel, and service transformer ground rod.
- D. Install ground rod at each transformer and make connection to all exposed metal parts.
- E. Provide exothermic or braze all concealed or below grade connections. Provide exothermic connections to building steel.
- F. Compression connections shall be made using a hydraulic 4-way compression die. All compression connections shall be exposed.
- G. Provide separate ground conductor the full length of all raceways.

3.2 GENERAL TERMINATIONS

- A. Burnish to bare metal under all grounding and bonding terminations to assure good ground continuity. Terminations are to be attached with separate screw and nut. When more than one termination is required, provide a separate ground terminal strip.

3.3 DEVICE OUTLET BOX

- A. Provide separate grounding conductor between the outlet box containing the device and the branch circuit grounding conductor.

END OF SECTION 26 05 26

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SECTION 26 05 29
HANGERS AND SUPPORTS

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 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.3 SUBMITTALS

- A. Product Data: Submit for each of the products provided.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line
 - 2. Thomas & Betts
 - 3. Unistrut
- C. Metallic Coatings: Hot-dip galvanized after fabrication.
- D. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating.
- E. Painted Coatings: Manufacturer's standard painted coating.
- F. Channel Dimensions: Selected for applicable load criteria.

- G. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- H. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- I. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used. Subject to compliance with requirements, provide products by one of the following manufacturers:
 - a. Hilti
 - b. ITW Ramset/Red Head
 - c. Simpson Strong-Tie
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used. Subject to compliance with requirements, provide products by one of the following manufacturers:
 - a. Cooper B-Line
 - b. Hilti
 - c. ITW Ramset/Red Head
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Conduit Crossing Structural Separation: Conduit that crosses structural or seismic separations between building units shall be installed with flexible connections, suitable to accommodate longitudinal and transverse displacements. Secure raceways each side of joint and provide minimum of 36 inches' length flexible conduit between building units.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 3/8 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits. Secure raceways and cables to these supports with two-bolt conduit clamps.

- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and low-voltage systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- 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. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners. In lieu of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete four inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than four inches thick.
 - 5. To Steel: Beam clamps.
 - 6. To Light Steel: Sheet metal screws.
- C. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 CONCRETE BASES

- A. Provide four-inch high concrete pads with chamfered edges for all floor-mounted equipment including switchboards, distribution panels, transformers, motor control centers and unit substations.
- B. Construct concrete bases of dimensions indicated but not less than four inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- C. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section.
- D. Anchor equipment to concrete bases.

END OF SECTION 26 05 29

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SECTION 26 05 33

RACEWAYS AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE

- A. Provide complete raceway systems as shown on the drawings and/or as required for proper installation of the various electrical systems being installed under this project. Minimum raceway size shall be $\frac{3}{4}$ ", except where a single circuit of two #12 AWG conductors are installed which required $\frac{1}{2}$ " conduit minimum.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Raceways: Allied, Carlon, Western or equal.
- B. Fittings: Appleton, Carlon, T&B, Steel City, O-Z/Gedney or equal.
- C. Conduit Straps: Appleton, Carlon, T&B, Steel City, O-Z/Gedney or equal.
- D. Low-Voltage Cable Supports: Caddy or equal.

2.2 RACEWAYS

- A. Rigid Aluminum Conduit: Not Permitted.
- B. Rigid Metallic Conduit: Zinc-coated steel with full threaded connections.
- C. Electrical Metallic Tubing (EMT): Zinc-coated steel.
- D. Rigid Nonmetallic Conduit: Rigid PVC, Schedule 40, UL listed for direct burial or concrete encasement.
- E. Flexible Metallic Conduit: Galvanized steel, securely interlocked.
- F. Liquidtight Flexible Metallic Conduit: Galvanized steel, interlocked, with integral ground conductor and PVC jacket overall.

2.3 FITTINGS

- A. Rigid Metallic Conduit:
 - 1. Couplings: Threaded metallic type of the same material as the conduit.
 - 2. Locknuts: Steel up to 2 inches, malleable iron for 2-1/2 inches and larger.

3. Bushings: Bakelite or plastic up to 2 inches, malleable iron with insulating collar for 2-1/2 inches and larger.
 4. Unions: Zinc plated malleable iron, 3 piece conduit coupling. Running threads are not acceptable.
- B. Electrical Metallic Tubing (EMT): Fittings shall be raintight type steel set screw type containing dual setscrews on each side of coupling. Set screws shall be steel. Cast metal will not be accepted.
- C. Rigid Nonmetallic Conduit: Slip-on, nonthreaded type of same material as conduit. Provide rigid steel bends in conduit runs.
- D. Flexible Metallic Conduit: Galvanized steel, one- or two-screw clamp type. All fittings shall be steel.
- E. Liquidtight Flexible Metallic Conduit: PVC waterproof cover over steel conduit, steel compression type. PVC waterproof flex without steel core is prohibited.
- F. Expansion Fittings: Provide expansion fittings for all rigidly fastened conduits spanning a building expansion joint, and for all runs 1-1/2" or larger exceeding 150 feet in length. Fittings shall be hot-dipped galvanized malleable iron with a packing ring to exclude water, a pressure ring, and a separate external copper bonding jumper.

2.4 CONDUIT STRAPS

- A. Heavy-duty one- or two-hole pressed steel straps. "Nail-in" style straps shall not be used.

2.5 LOW VOLTAGE OPEN CABLING SUPPORTS

- A. J-Hooks: Shall comply with TIA requirements for structured cabling system. Galvanized finish. Caddy #CAT21 with CATHBA angled hanger bracket. Provide all hardware necessary for secure mounting to the structure. Follow manufacturer's recommendations for quantity of cables supported.
- B. Adjustable Cable Support: Shall comply with TIA requirements for structured cabling system. Caddy #CAT425. Follow manufacturer's recommendations for quantity of cables supported.
- C. Provide all accessories and mounting hardware required for a complete and working installation of open cabling supports.

PART 3 - EXECUTION

3.1 COORDINATION

- A. The Contractor shall review all drawings, details and elevations and coordinate with the Architect prior to rough-in, all installations of wiring devices and equipment. Where equipment is furnished by others, the Contractor shall ascertain the proper voltage, load and connection requirements prior to rough-in.

3.2 MATERIALS

- A. All materials of a specific type shall be provided by the same manufacturer throughout the project. These products shall be identical to those submitted for review.

3.3 RACEWAY INSTALLATION

- A. Raceway Types: Install raceway types and sizes as listed below:

1. Rigid Metallic Conduit: In concrete, masonry, exposed exteriors and exposed interiors where subject to physical damage and as required by code enforcing agencies.
2. Electrical Metallic Conduit (EMT): All areas other than above. May be used for feeders with integral green ground conductor.
3. Flexible Metallic Conduit: Recessed fixture connections, interior concealed equipment connections, expansion and seismic joints and sound control. Not to be used for exposed installations within the building.
4. Liquidtight Flexible Metallic Conduit: Exterior equipment connections and exposed installation within the building.
5. Rigid Nonmetallic Conduit: Exterior underground installations.
6. See referenced Signal and Communications specification sections for raceways associated with these systems.

- B. Installation:

1. Planning: The layout of all raceways shall be carefully planned by the Contractor to ensure an installation which is neatly done and workmanlike. Any work showing improper care in planning will be ordered removed by the Architect, and shall be replaced in a neat and proper manner, without any additional cost to the Owner.
2. Concealment: All raceways shall be concealed in finished areas unless approved otherwise by the Architect. Where existing wall surfaces are inaccessible, surface metal raceways for these exceptions may be provided when approved by the Architect. Raceways may be surface mounted in unfinished equipment spaces such as mechanical rooms, electrical rooms, elevator machine rooms, and attic spaces.
3. Cutting and Bending: Raceways shall have smooth interior, ends cut square and reamed. Bends shall be carefully made to avoid injuring or flattening raceways (no "Hickey" bends).
4. Exposed Raceways: Install exposed raceways as high as possible, above ductwork, parallel or at right angles to building lines.
5. Expansion and Earthquake Joints:
 - a. Raceways shall not be installed in concrete slab or wall construction when passing through an expansion or earthquake joint.
 - b. Raceways shall be installed in furred or suspended ceiling spaces with a minimum of 36 inches of flexible conduit crossing the expansion or earthquake joints. Secure raceways each side of joint.
6. Routing: All raceways shall be installed parallel or at right angles to the building construction unless prohibited by a physical obstruction. This applies to all exposed raceways as well as all raceways above suspended ceiling.

7. Raceway Supports: Raceways shall be supported with heavy-duty, one- or two-hole, pressed steel straps on interior surfaces. Support pendant-mounted raceways on 3/8-inch rod with pear-shaped hanger or trapeze-type hanger with 3/8-inch rod (minimum) and 1-5/8-inch square preformed channel and pipe clamps. Parallel, surface-mounted raceways shall be supported from 1-5/8-inch square preformed channel and pipe clamps. All fittings and supports shall be hot-dip galvanized in exterior areas. Preformed channel in areas above suspended ceilings may be standard painted finish. Multiple conduit runs shall be grouped and neatly racked on trapeze hangers.
8. Anchorage: Anchor to metal stud structures by means of sheet metal screws or manufactured spring steel clips. Fasten individual raceways supports to structural walls or slabs with steel expansion shells and bolts. Provide flush concrete insert for multiple raceway support system. Fasten to structural steel with heavy-duty beam clamps. Fasten to architectural or masonry walls with toggle bolts or molley screws.
9. Independent Support: Conduits shall not be supported from the ceiling suspension system, ducts, pipes or other systems foreign to the electrical installation. The entire electrical installation shall be kept independent from any other trade.
10. Suspended Ceiling: Branch circuit raceways and outlet boxes installed above suspended ceilings may be secured to No. 9 AWG or larger support wires that are independent of the ceiling suspension system under the following conditions:
 - a. Raceways and cables are not larger than 3/4" trade size.
 - b. No more than two raceways or cables are supported by a support wire.
 - c. Raceways and cables are secured to the support wires by fittings designed and manufactured for the purpose.
 - d. The support wires are securely fastened to the structural ceiling and to the ceiling grid system.
 - e. The raceways or cables serve equipment that is located within the ceiling cavity or is mounted on or supported by the ceiling grid system.
 - f. Where not prohibited by the building code officials.
 - g. Conduit Location: Conduit shall not be run under heavy equipment, footings or other structural elements that might adversely affect the integrity of the raceways system or building footing. All raceways installed above suspended ceilings must be kept a minimum of 6" clear above top of ceiling system.
 - h. Floor Slabs and Columns: Conduits installed in structural floor slabs shall be coordinated with structural steel and shall be routed to provide a maximum concrete cover. In general, conduit shall not be installed in structural columns, unless special permission is granted by the Architect.
 - i. Pullboxes with Covers: Shall be provided as shown on the drawings or as required by Code. All pullboxes shall be located so as to be accessible.
 - j. Flexible Conduit: Shall be used only for lighting fixture pigtails in accessible ceilings, flush-mounted speaker pigtails in accessible ceilings, sound control, motor connections and at building expansion joints as specified. Installations shall not exceed 6'0" in length. Any other proposed use of flexible conduit must be approved by the Architect's representative.
 - k. Metallic raceway shall be continuous and bonded/grounded. Transitions to ceiling, crawl or tunnel spaces are to be made from a junction box on the "concealed space" side of the penetration.
 - l. Conduit Stubs: Conduit which stub-up through the floor shall be installed at such a depth that none of the curved section of the elbow is visible.
 - m. Sealing: All conduit, sleeves, blockouts or openings around raceway and cable systems that penetrate building walls, floors and ceilings shall be sealed. Sealing materials shall be fire-rated, non-combustible type, specifically designed for this type of installation and shall be approved by the authority having jurisdiction.

- n. Penetrations: Raceways which pass through building roof, exterior walls of building above or below grade and floor slabs on grade shall be sealed on the interior side of the building using non-hardening sealing compound after all conductors have been installed in the raceway. Sealing material shall be specifically designed for electrical wiring systems.
 - o. Conduit Passing Through Building Roof: Provide a 4 lb. lead plumbing vent flashing with a counterflashing attached above using a galvanized steel clamp. Flashing shall be in accordance with NRCA standards practices.
 - p. Conduit Penetrating Membranes: All conduits penetrating walls or slabs with membranes shall be installed with approved membrane clamping devices in order to provide necessary seal.
 - q. Exterior Walls: Conduits passing through exterior walls below grade and/or bridging an area which was previously excavated and backfilled shall be rigidly supported by a structurally reinforced concrete duct bank spanning between the building wall and a bearing surface on undisturbed earth.
 - r. Cleaning of Raceways: The interior and exterior of all conduits and other raceways shall be thoroughly cleaned of all material. All conduits shall be capped or plugged after installation to ensure that they remain clean.
 - s. No section of conduit shall be longer than 100 feet or contain more than three (3) 90 degree bends between pull points or pull boxes.
 - t. Rigid non-metallic conduit shall not be used in above grade floor slabs, or in wall or open spaces of any type.
 - u. Minimum size conduit to be $\frac{3}{4}$ " (metallic and non-metallic).
 - v. Electrical metallic tubing (EMT): EMT shall be used in concealed spaces. EMT may not be used in finished areas unless indicated on the drawings. EMT may be used for exposed work in unfinished areas where not exposed to physical damage. Raceways in traffic areas shall be considered exposed to physical damage where within 10 feet of floor. If used in finished areas, must be painted to match existing wall/surface color.
 - w. Multiple rows of suspended conduits shall be supported from Trapeze style hangers, providing 20% spare room for future raceways.
 - x. Rigid non-metallic conduit install underground shall be buried a minimum of 24" and a maximum of 30" under grade.
 - y. Utilize rigid steel conduit below all roadways. Installed at depths less than 24" conduit shall be encased in conduit. Over 24" depth, wrap with scotch insulation tape, or utilize conduit with factory applied PVC coating.
 - z. Raceway shall be installed with a minimum separation of 12 inches of free air from steam and hot water piped and a minimum separation of 3 inches of free air space from all other mechanical piping.
- C. Dissimilar Materials: Keep electrical conduits free from contact with all other piping runs of different systems or of dissimilar metals.
- 3.4 RACEWAYS AND CABLE INSTALLATION PATHWAYS FOR LOW VOLTAGE SYSTEMS
- A. Installation of Raceways/Pathways for intercom, clock, telecommunications and CATV systems shall be in accordance with the applicable portions of ANSI/TIA/EIA-569-A, Commercial Building Standards for Telecommunications Pathways and Spaces.
 - B. Conduits above lay-in ceilings: Do not install cables in conduits that are supported from the ceiling suspension system. All conduits shall be supported independently of the ceiling support system.
 - C. Conduit fill shall not exceed 40%.

- D. Bend radii for conduits shall meet the following requirements:
1. If the conduit has an internal diameter of 2 inches or less, the bend radius must be at least 6 times the internal conduit diameter.
 2. If the conduit has an internal diameter of more than 2 inches, the bend radius must be at least 10 times the internal conduit diameter.
- E. There shall be no more than two 90 degree bends between pull points in telecommunications conduit, without derating of the conduit capacity. For each additional 90 degree bend the conduit capacity shall be derated by 15 percent. Increase conduit size as required to meet conduit fill requirements of this section with the derated capacity accounted for. Or, provide pull boxes to eliminate 90 degree bends as necessary to avoid having to derate conduit. Offsets shall be considered as equivalent to a 90 degree bend. Pull boxes added to conduit runs as of result of this requirement shall be in accordance with this section.
- F. Conduits which are terminated at cable trays shall be supported from structure with a maximum distance of 24" from the tray. Conduits terminated at cable trays shall be bonded to the tray.
- G. Exterior conduit shall be 4" Schedule 40 PVC with GRC elbows transitioning to 4" GRC for Service Entrances. Interior conduit for vertical riser cable shall be GRC, sized per ANSI/TIA/EIA-568-A-5 or as indicated on the Contract Drawings. Interior conduit for horizontal cable shall be EMT, sized per ANSI/TIA/EIA-568-A-5 standards or as indicated on the Contract Drawings.
- H. Use of flexible conduit for telecommunications shall be kept to a minimum and shall be at the discretion of the Contracting Agency. Obtain prior written approval for the use of flexible conduit. Where required due to physical considerations, flexible metal conduit may be allowed in lengths not exceeding 4 feet. If used, flexible metal conduit shall be increased by one trade size for the application used.
- I. Conduits entering the MDF room through the floor shall be terminated 4 inches above finished floor. Conduits entering the MDF room from above shall be terminated 4 inches below the finished ceiling, but in no case shall the conduits terminate greater than 12 inches above the cable tray or distribution frame.
- J. Conduits and cut-out openings between floors shall be sealed with firestopping material which is removable and reusable, to accommodate adds, moves and changes in the cabling system.
- K. All conduits used for routing of low voltage cables shall have bushings at all stubouts.

3.5 OPEN CABLE SUPPORT AND INSTALLATION PATHWAYS

- A. Where cables are indicated to be installed as "Open Cabling", cable supports (D-rings, J-hooks, adjustable straps, and saddles as appropriate) shall be installed to allow cabling to be grouped and run along a common path. Cables shall be run parallel or at right angles to the building structure, and shall not be looped diagonally across the ceiling space. Cables shall be loosely bundled with cable ties at minimum every 30 inches on center. Provide cable ties at closer intervals where called for on drawings. Provide plenum rated Teflon cable ties in spaces used to handle environmental air.
- B. Do not support cables from ductwork, sprinkler piping, water piping, waste piping or electrical conduit.

- C. Fire seal around all cables running through rated floors and walls in accordance with Section 26 05 00.

END OF SECTION 26 05 33

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SECTION 26 05 40

OUTLET, JUNCTION AND PULL BOXES

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all outlet, junction and pull boxes required for proper installation of electrical equipment being installed under this work.

1.2 COORDINATION

- A. The Contractor shall review all drawings, details and elevations and coordinate with the Architect and equipment supplier prior to rough-in, all installations of wiring devices and equipment. Where equipment is furnished by others, the Contractor shall ascertain the proper voltage, load and connection requirements prior to rough-in.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Boxes: Appleton, Circle AW, Crouse-Hinds, Raco, Steel City, Wiremold or equal.
- B. Fittings: Appleton, Circle AW, Crouse-Hinds or equal.
- C. Classroom Floor Boxes: Hubbell.
- D. Kitchen Floor Boxes: Brownfield.
- E. Multi-System Wall Boxes: Hubbell.

2.2 OUTLET AND DEVICE BOXES

- A. Interior Surface-Mounted in Unfinished Areas: One-piece pressed steel, electro-galvanized, size and depth required by Code, except 4-inch square or 4-inch octagonal minimum. Minimum 14 U.S. gauge, with return flange and screw retained cover.
- B. Interior Flush-Mounted: Galvanized pressed steel, knockout type, not less the 4" square, 2-1/8" deep, minimum 14 U.S. gauge, with return flange and screw retained cover. Provide extension rings for all flush boxes. Boxes which occur in concrete block walls shall be equipped with 1 1/2" square cornered tile extensions.
- C. Interior Surface-Mounted, Finished Areas: Wiremold No. 5700 Series sized to fit standard wiring device, covers specified below.

- D. Outlets boxes installed in surface metallic raceway systems shall be shallow boxes manufactured as part of the system.
- E. Exterior Mounted: Cast, non-ferrous metal with threaded hubs required, cast gasketed covers. Manufacturers as listed above.
- F. Prohibited Materials: Sectional outlets boxes shall not be utilized.

2.3 JUNCTION AND PULL BOXES

- A. 100 cubic inches or smaller: Standard outlet box with stamped knockouts.
- B. 150 cubic inches or larger: Code gauge steel with sides formed and welded, with screw covers unless shown to have hinged doors. Hinged doors shall have locking device same as furnished for panelboards.
- C. Knockouts shall be factory stamped, or formed in the field with a cutting tool to provide a clean symmetrically-cut hole.
- D. Interior Areas: Steel, screw cover, Code gauge and size, baked enamel finish.
- E. Exterior or Wet areas: Weatherproofed galvanized steel construction with proper gaskets and corrosion resistant fasteners.
- F. Device outlets shall be a minimum of 2-1/8" inches deep, minimum 4 inches square.
- G. For existing walls, use 2 1/2" deep min. cut in box.
- H. Prohibited materials: "Handy Boxes"

2.4 FITTINGS

- A. Junction boxes or elbows may be cast conduit fittings at Contractor's option. Provide one size larger than raceway for feeders - "mogul-type." Openings accessible at all times. Exterior areas to be cast aluminum with gasketed non-ferrous covers.

2.5 LIBRARY/MULTI-PURPOSE ROOM FLOOR BOXES

- A. Recessed steel floor box with all accessories required to mount the receptacle and communications outlets shown on the drawings. Floor box cover shall be flush with top of finished floor. Cover shall be suitable for floor covering in room. Manufacturer: Hubbell HBLCFB301 series base on first floor and HBLCFB401 series shallow base for second floor with HBLTCGNT series metallic mop-tight flush cover. For tile floors provide plywood filler panel inside cover such that tile is flush with top of the cover. Secure plywood to coverplate with construction adhesive.

2.6 KITCHEN FLOOR BOXES

- A. Above-floor, heavy-duty, die-cast aluminum frame, brushed aluminum housing, stainless steel faceplate pedestal-style fitting mounted on a floor box cover with all accessories required to mount receptacles shown on the drawings. Supporting floor box shall be as described in Section 2.5. Manufacturer: Hubbell SC3098A.

2.7 MULTI-SYSTEM WALL BOX

- A. Recessed wall box with modular faceplates to accommodate receptacles and special systems devices as shown on the drawings. Provide barrier to divide box for high and low-voltage wiring. Provide four-gang box for up to three devices. Provide six-gang box for four or more devices. Box depth shall be 3.5". Hubbell Multi-Connect series wall box with wall flange and faceplates to accommodate devices shown on the drawings.

PART 3 - EXECUTION

3.1 GENERAL

- A. Boxes shall be supported securely and independently. Mount boxes on building surfaces or support with trapeze hanger as described in Raceway Installation. Junction boxes shall not be used unless the number of bends, pulling length, or circuit requirements necessitate their installation. Junction or pullbox openings must be accessible. All boxes must be supported independently of any other building system.
- B. Coordinate and locate boxes to ensure accessibility of electrical wiring.

3.2 DEVICE BOXES

- A. Outlet and device boxes mounted in stud walls shall be attached to two adjacent wall studs using blocking material behind the box to ensure that the box will remain square to the finished wall surface.
- B. Outlet and device boxes mounted in masonry walls shall be set at the bottom or top of a masonry unit course.
- C. Plaster rings shall be provided for all devices in walls with finished materials such as gypsum wallboard, plaster, etc. Plaster ring shall extend outlet box to within 1/8-inch of finished wall surface including all wall coverings. Coordinate with Architectural finishes prior to rough-in.
- D. Grout around all outlet boxes to seal space between box and wall or ceiling materials.
- E. Exterior Wall Outlets: Conduit shall not enter the bottom of exterior wall outlet boxes. Conduit shall enter the sides and top only.
- F. Multiple Gang Outlet: Install two or more wiring devices shown in one location under a common plate except when outlets are of a different voltages such as telephone and duplex receptacles. Install plates with all edges in continuous contact with finished wall surfaces. Install plates vertically with alignment tolerance of 1/16-inch. Sectional plates are not permitted. No more than one device shall be installed in a single-gang position.

- G. Device Locations: Locate switches 6 inches from door casing unless otherwise shown. Outlets mounted above one another shall be on the same centerline. Coordinate exact locations of any special devices with Architect. All outlet heights must comply with all handicap accessibility requirements. Heights to center of outlet mounted vertically shall be as follows unless otherwise shown:

1. Convenience Outlets: +18"
2. Above Counter Outlets: Verify height. Minimum clearance one inch above backsplash or counter as applicable.
3. Switches: 4'-0"
4. Electric Water Coolers: Conceal outlet behind equipment housing.
5. Where different type devices occur adjacent to each other, space outlet boxes so that finish plates will be spaced a minimum of one inch apart at same height.

3.3 BLANK COVERS

- A. Provide blank covers or plates over all boxes that do not contain devices or are not part of an equipment connection.

3.4 LABELING

- A. All junction and pull boxes in accessible ceiling spaces and exposed in unfinished areas shall be identified to indicate the branch circuit numbers, feeders, or signal and communication system contained within. Use permanent label. Fire Alarm System shall be red color. Refer to Section 27 05 00 for requirements pertaining to Signal and Communication System.

3.5 JUNCTION OR PULL BOXES

- A. No box shall be secured to the ceiling system, HVAC ductwork, or mechanical piping.
- B. Pull and junction boxes shall be installed as shown or as necessary to facilitate pulling of wire and to limit the number of bends within code requirements. Boxes shall be permanently accessible and shall be placed only at locations approved by the Architect. Secure boxes rigidly to the building element on which they are mounted, or solidly embed boxes in concrete or masonry. Identify all pull and junction boxes with a permanent label, neatly showing the individual feeder or electrical system. Installations shall only be above accessible ceiling, crawl spaces, tunnels and in unfinished areas only.

3.6 SOUND CONTROL

- A. General: The installation of outlet boxes and conduit shall utilize installation methods which minimize sound transmission from one room to adjacent rooms or areas.
- B. Installation: Where boxes are mounted in a common wall, they shall wherever possible, be offset horizontally so that they are not mounted back to back. Connect offset boxes with EMT conduit not to exceed 18 inches in length. Where it is not practical to offset boxes, with permission they may be mounted back to back with a minimum clearance of 1/4-inch between boxes and with a sheet of high-density fiberglass between boxes.

3.7 EXTENSION RINGS

- A. A maximum of one extension ring shall be provided on each junction box.

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SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS

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 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.3 SUBMITTALS

- A. Product Data: Submit for each type of product provided.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide complete seismic anchorage and bracing for all electrical raceways, cable trays, fixtures and equipment as required by the International Building Code (IBC) Section 1621.
- B. Retain the services of a professional licensed structural engineer to design the required seismic anchorage and bracing.
- C. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: D.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I.
 - a. Component Importance Factor: 1.5 for essential systems, 1.0 for nonessential systems.
 - b. Component Response Modification Factor: 5.0.
 - c. Component Amplification Factor: 2.5.
 - 3. Design Spectral Response Acceleration at 1.0-Second Period.
 - 4. Essential Systems:
 - a. The following electrical equipment, raceways and spaces are considered essential for the continued operation of the facility:
 - 1) All electrical, generator and communications rooms.
 - 2) All life-safety distribution equipment, feeders and raceways.
 - 3) All equipment and feeders rated 225 amperes and above.
 - 4) All cable trays.
 - 5) All fire alarm system equipment and raceways.

- 6) All intercom/clock system equipment and raceways.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Isolation Technology, Inc.
 2. Vibration Isolation
- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
- C. Resilient Material: Oil and water-resistant neoprene.
- D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and Authorities Having Jurisdiction.
 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.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line
 2. Hilti Inc.
 3. TOLCO Incorporated
 4. Unistrut
- B. General Requirements for Restraint Components: Rated strengths, features and application requirements shall be as defined in reports by an agency acceptable to Authorities Having Jurisdiction.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with 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; and rated in tension, compression and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to Authorities Having Jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners 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 will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
1. Install restrained isolators on electrical equipment.
 2. Install seismic-restraint devices using methods approved by an agency acceptable to Authorities Having Jurisdiction providing required submittals for component.

- B. 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.
- C. 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.
- D. Drilled-in Anchors:
 - 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 the 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 Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: 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.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.4 ADJUSTING

- A. 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.
- B. Adjust active height of spring isolators.
- C. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 05 48

SECTION 26 05 53

IDENTIFICATION

PART 1 – GENERAL

1.1 SCOPE

- A. Provide proper identification of all electrical work specified. This shall include but not be limited to the following items: service and distribution equipment, starters, disconnects, cabinets, terminal boxes, device junction boxes, danger signs, maintenance access points, and fused switches including fuse size and type.
- B. Install nameplates on all main and distribution switchboards, panelboards, disconnect switches, and miscellaneous systems junction boxes and cabinets installed under this contract.
- C. Install bakelite nameplates at each protective device in switchboard and distribution centers, showing circuit service.
- D. Install circuit directory cards in all panelboards. Cards shall be typed or computer printed.
- E. All wiring in all outlet and junction boxes shall be properly identified as to circuit number. Type of marker shall be made with Brady ID Pro printer/labeler with $\frac{3}{4}$ " labels, or approved equal. Locate label on inside of device box. Label shall be black letters on white background using Brady #42019 tape and #42011 ribbon.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Prohibited Materials
 - 1. Dymo (or equivalent) labels shall not be utilized, unless specifically noted.
- B. Schedules – provide typewritten directory for each panel, on heavy card stock, showing all circuit numbers.

2.2 EQUIPMENT NAMEPLATES

- A. Nameplates shall be fabricated from white bakelite, with $\frac{3}{8}$ " engraved black letters.
- B. Mounting: Nameplates shall be attached with a minimum of two 6-32 roundhead screws, lockwasher and nuts in exterior locations and contact-type permanent self-adhesive in indoor locations.

2.3 SWITCHBOARDS AND DISTRIBUTION PANELBOARDS

- A. General: Provide nameplate which identifies the switchboard/distribution panel and the source panel. (Example: Distribution Panel No. 1/Fed from Main Service Switchboard - Bkr. No. 1.)
- B. Overcurrent Devices: Provide nameplate at each overcurrent device that identifies the device number and the load served. (Example: Bkr. No. 1/Panel A.)

2.4 PANELBOARDS

- A. Provide nameplate on the front of the panel room which identifies the panel. (Example: Panel A.) Provide a nameplate concealed behind the door which identifies the panel, and the source panel. (Example: Panel A, Fed from Distribution Panel 1-Bkr. No. 2)

2.5 DISCONNECT SWITCHES AND MOTOR STARTERS

- A. Provide nameplate which identifies the source panel, load served and the fuse size where applicable. (Example: Panel A-1,3,5/Exhaust Fan No. 1/10 amp, RK1 fuses.)

2.6 JUNCTION AND PULL BOX IDENTIFICATION

- A. Mark the cover of all junction boxes and pull boxes to identify the system, circuits, or feeders contained within the box. Use red color for fire alarm. Circuits shall be identified by panelboards and specific circuit numbers contained within the junction box. Refer to specification Sections 26 05 40 and 27 05 00.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Clean all surfaces prior to installing labels. Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
- B. Nameplates
 - 1. Panelboards: Mount inside door, on dead front, above circuit breakers, unless panelboard is located in a utility-type room, then install nameplate on outside of panelboard above door.
 - 2. Disconnect switches: Mount nameplate on outside of cabinet, near top. Omit nameplate from disconnect switches if located adjacent to equipment.
- C. Schedules
 - 1. Panelboards: Mount in frame under plastic cover, on back side of door. Schedule shall be typed or printed and show circuit service for each circuit breaker, using room numbers. Spares and spaces shall be written in pencil.

3.2 REGULATIONS

- A. Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.3 DANGER AND WARNING SIGNS

- A. General: In addition to installation of danger signs required by governing regulations and authorities, Contractor shall be responsible for installing appropriate danger signs at locations constituting danger for persons in or about project.
- B. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power.

END OF SECTION 26 05 53

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SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The purpose of this section is to specify the Contractor's responsibilities relative to Division 26 and participation in the commissioning process. See Division 1, Section 01 91 00, "Commissioning," for Contractor-related commissioning requirements.
 - 1. Organization of the commissioning program is primarily the responsibility of the Commissioning Authority. Execution of the program is primarily the responsibility of the Contractor with support from the Division 26 for:
 - a. Testing and start-up of the electrical equipment.
 - b. Completion and endorsement of pre-functional test checklists provided by the Commissioning Authority to assure that Division 26 equipment and systems are fully operational and ready for functional testing.
 - c. Providing qualified personnel to assist the Commissioning Authority with functional testing to verify equipment/system performance.
 - d. Providing equipment, materials, and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
 - e. Providing training for the systems specified in Division 26 with coordination of Owner by the Commissioning Authority.
- B. Division 26 shall cooperate with the Commissioning Authority in the following manner:
 - 1. Allow sufficient time before final completion dates so that electrical testing, lighting control checkout, and functional testing can be accomplished.
 - 2. Provide labor and material to make corrections when required without undue delay.
 - 3. Put all electrical systems and equipment into full operation and continue the operation of the same during each working day of commissioning.
- C. Related Sections
 - 1. Section 01 91 00 - Commissioning
 - 2. Division 23 - Mechanical
 - 3. Division 26 - Electrical

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Standard certified test equipment for commissioning will be provided by the Commissioning Authority.
- B. Proprietary test equipment required by the manufacturer shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.

PART 3 - EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

- A. Specific pre-commissioning responsibilities of Division 26 are as follows:
 - 1. Normal start-up services required to bring each system into a fully operational state.
 - 2. Complete pre-functional test checklists for all equipment and systems to be commissioned
 - 3. Portions of mechanical equipment start-up requiring electrical connections and metering.
 - 4. Factory start-up services for key equipment and systems specified in Division 26. The Division 26 Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.
 - 5. Demonstrate system readings as requested by the Commissioning Authority and adjust units to achieve specified operation.

3.2 PARTICIPATION IN COMMISSIONING

- A. The Division 26 Contractor shall provide skilled technicians to start-up and debug all systems within the Division 26 work (particularly with lighting equipment). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed upon schedules, and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.
- C. Provide skilled technicians to manipulate the following equipment and systems to be commissioned for functional testing:
 - 1. Lighting control systems
 - 2. Day lighting control system

3.3 WORK TO RESOLVE DEFICIENCIES

- A. Maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet Acceptable Performance. Correction of work will be completed under the direction of the Owner/Architect, with input from the Contractor, Equipment Supplier, and Commissioning Authority. Whereas, all members will have input and the opportunity to discuss, debate, and work out problems, the Architect/Engineer-of-Record will have final jurisdiction on the necessary work to be done to achieve performance and/or design intent.

3.4 ELECTRICAL SYSTEM TESTING

- A. Electrical system testing as required in other sections of this specification shall be coordinated with the Commissioning Authority. The Commissioning Authority may witness testing performed by the Division 26 Contractor.

- B. All testing documentation related to Division 26 equipment and systems, as specified in other sections of this specification, will be provided to the Commissioning Authority for use and review.

3.5 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

- A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon as contract work is completed regardless of season. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes, with a fully occupied building. The Contractor will be responsible to participate in the initial and the alternate peak season test of the systems required demonstrating performance.
- B. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum, and at peak loads to observe system performance. The Contractor will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.
- C. Day lighting control set-up and commissioning needs to be done in the worst and best case scenario. The best case scenario is as close to the summer solstice as possible and on a full sun day (with no cloud cover). This final set up and commissioning should be scheduled with the Commissioning Agent to minimize site visits and mis-communications.

3.6 TRAINING

- A. The Division 26 Contractor will be required to participate in the training of the Owner's engineering and maintenance staff for each electrical system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner's option.

END OF SECTION 26 08 00

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SECTION 26 09 43
NETWORK LIGHTING CONTROLS

PART 1 – GENERAL

1.1 SUMMARY

- A. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
- C. All system devices shall be networked together enabling digital communication and shall be individually addressable.
- D. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.
- E. The system architecture shall facilitate remote operation via a computer connection.
- F. The system shall not require any centrally hardwired switching equipment.
- G. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.

1.2 SUBMITTALS

- A. Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)
- B. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)
- C. Shop Drawings – Plans based on lighting sheets locating any and all devices required for a fully operational lighting control system.
- D. Other Diagrams – as needed for special operation or interaction with other system(s)
- E. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
- F. Hardware and Software Operation Manuals
- G. Other operational descriptions as needed

1.3 QUALITY ASSURANCE

- A. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.

- B. All components and the manufacturing facility where product was manufactured must be ROHS compliant.
- C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.4 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
- B. Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs.
- C. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.5 WARRANTY

- A. All devices in the lighting control system shall have a 5 year manufacturer's warranty.
- B. Warranty period shall begin after the completion of the installation and the system's start-up and training, the point at which the system owner receives beneficial use of the control system or 1 year after shipment from the manufacturer, whichever occurs first.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer:
 - 1. Hubbell NX Distributed Intelligence
 - 2. nLight Network Control System
 - 3. Douglas Lighting Controls
 - 4. As approved by the engineer and owner
- B. The basis of design product is a distributive lighting control system described throughout this specification and drawings. Other lighting controls system substitutes will be considered as long as they provide similar functionality, are acceptable to the owner, and are submitted as a substitute as described.
- C. Substitutions:
 - 1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.

2. By using pre-approved substitutions, the contractor accepts responsibility and all associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 SYSTEM/NETWORK REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section)
- D. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.
- E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
- G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.
- J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- K. System shall have one or more primary wall mounted network control "gateway" devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
- L. System shall use "bridge" devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.

- M. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.
- N. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- O. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via wired backbone.
- P. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.
 - 1. Auto-On / Auto-Off (via occupancy sensors)
 - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - c. Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
 - 2. Manual-On / Auto-Off (also called Semi-Automatic)
 - a. Pushing a switch will turn lights on.
 - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
 - 3. Manual-On to Auto-On/Auto-Off
 - a. Pushing a switch will turn lights on.
 - b. After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
 - c. Sequence can be reset via scheduled (ex. daily each morning) events
 - 4. Auto-to-Override On
 - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - b. Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - c. Sequence can be reset via scheduled (ex. daily each morning) events
 - 5. Manual-to-Override On
 - a. Pushing a switch will turn lights on.
 - b. Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
 - c. Sequence can be reset via scheduled (ex. daily each morning) events
 - 6. Auto On / Predictive Off
 - a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
 - b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

- c. If switch is pressed, lights turn off and a short “exit timer” begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
7. Multi-Level Operation (multiple lighting levels per manual button press)
- a. Operating mode designed specifically for bi-level applications
 - b. Enables the user to cycle through the up to four potential on/off lighting states using only a single button.
 - c. Eliminates user confusion as to which of two buttons controls which load
 - d. Three different transition sequences are available in order to comply with energy codes or user preference)
 - e. Mode available as a setting on all devices that have single manual on/off switch.
 - f. Depending on the sequence selected, every button push steps through relays states according to below table
 - g. In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present.
- Q. A taskbar style desktop application shall be available for personal lighting control.
- R. An application that runs on “smart” handheld devices (such as an Apple® iPhone®) shall be available for personal lighting control.
- S. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.
- T. Control software shall enable integration with a BMS via BACnet IP.
- U. System shall provide the option of having pre-terminated plenum rated CAT-5 cabling supplied with hardware.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

A. Control Module (Gateway)

- 1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.
- 2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
- 3. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.
- 4. Device shall automatically detect all devices downstream of it.
- 5. Device shall have a standard and astronomical internal time clock.
- 6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
- 7. Device shall have a USB port
- 8. Each control gateway device shall be capable of linking 1500 devices to the management software.
- 9. Device shall be capable of using a dedicated or DHCP assigned IP address.

B. Networked System Occupancy Sensors

- 1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.

2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.
7. Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
10. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
13. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
14. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
16. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
17. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
18. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
19. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls
20. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
21. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection
22. Embedded sensors shall have an optional photocell

23. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
24. Fixture mount sensors shall be capable of powering themselves via a line power feed.
25. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
26. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).
27. Embedded sensors shall have an optional photocell and 0-10 VDC dimming output

C. Networked System Daylight (Photocell and or Dimming) Sensors

1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).
5. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
8. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load. Relays shall be dry contacts.

D. Networked System Power (Relay) Packs

1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
3. All devices shall have two RJ-45 ports.
4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button or remote.
5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
7. Power Packs and Power Supplies shall be available that are WiFi enabled.
8. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.
9. Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.
11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
12. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
13. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
14. Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.
15. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.
16. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
17. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
18. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

E. Networked System Relay & Dimming Panels

1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection

F. Networked Auxiliary Input / Output (I/O) Devices

1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a 1/2" knockout.
2. Devices shall have two RJ-45 ports
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).
5. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.

6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output
7. Specific I/O devices shall sense state of low voltage outdoor photocells
8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
9. Specific I/O devices shall sense.

G. Networked System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Devices shall be available with zero or one integrated Class 1 switching relay.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. All sensors shall have two RJ-45 ports.
5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
6. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
7. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
8. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
9. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
10. Devices with mechanical push-buttons shall be made available with custom button labeling
11. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

H. Networked System Graphic Wall Station

1. Device shall have a 3.5" full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.
2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
3. Device shall enable user supplied .jpg screen saver image to be uploaded.
4. Device shall surface mount to single-gang switch box
5. Device shall have a micro-USB style connector for local computer connectivity.
6. Device shall have two RJ-45 ports for communication
7. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
8. Device shall recess into single-gang switch box and fit a standard GFI opening.
9. Devices shall provide LED user feedback.
10. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
11. All sensors shall have two RJ-45 ports.
12. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
13. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
14. Device shall have LEDs indicating current selection.

I. Communication Bridges

1. Device shall surface mount to a standard 4" x 4" square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.4 LIGHTING CONTROL PROFILES

- A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
- D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- E. All lighting control profiles shall be stored on the network control gateway device and on the software's host server.
- F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5 MANAGEMENT SOFTWARE

- A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software

- B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- D. A printable network inventory report shall be available via the software.
- E. A printable report detailing all system profiles shall be available via the software.
- F. Software shall require all users to login with a User Name and Password.
- G. Software shall provide at least three permission levels for users.
- H. All sensitive stored information and privileged communication by the software shall be encrypted.
- I. All device firmware and system software updates must be available for automatic download and installation via the internet.
- J. Software shall be capable of managing systems interconnected via a WAN (wide area network)

2.6 BMS COMPATIBILITY

- A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.
- B. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.
- C. BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

2.7 SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE

- A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.
- B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.
- C. An "Energy Scorecard" shall be display that shows calculated energy savings in dollars, KWHr, or CO₂.
- D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).
- E. Energy savings data shall be calculated for the system as a whole or for individual zones.

- F. A time scaled graph showing all relay transitions shall be presented.
- G. A time scaled graph showing a zones occupancy time delay shall be presented
- H. A time scaled graph showing the total light level shall be presented.
- I. User shall be able to customize the baseline run-time hours for a space.
- J. User shall be able to customize up to four time-of-day billing rates and schedules.
- K. Data shall be made available via a .CSV file

2.8 START-UP & SUPPORT FEATURES

- A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
- B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
- C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.
- D. All system devices shall be capable of being given user defined names.
- E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
- F. All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. All equipment shall be installed in accordance with manufacturer's installation instructions and in compliance with all applicable local and national codes and requirements.
- B. All wireless devices shall come with MAC address labels. These labels should be affixed to the fixture/device that contains the wireless module and in a log book or on as-builds where the location of the wireless device can be recorded.
- C. Provide complete installation of system in accordance with Contract Documents.
- D. Provide room by room documentation on the commissioning of the system including by not limited to the following:
 - 1. Sequence of operations
 - 2. Device settings
 - 3. Load parameters
 - 4. Schedules

3.2 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.
- C. Upon completion of the system commissioning, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

3.3 PROJECT COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per General Commissioning Requirements and Commissioning of Electrical Systems. The contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
- B. Identify controlled circuits in lighting contactors.
- C. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- D. Label time switches and contactors with a unique designation.

END OF SECTION 26 09 43

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SECTION 26 22 00

LOW VOLTAGE TRANSFORMERS

PART 1 – GENERAL

1.1 SCOPE

- A. Provide all dry-type transformers as indicated on drawings and as specified herein.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

- A. Acme, GE, Square D, Federal Pacific, Eaton, Siemens. Catalog numbers refer to Square D to establish minimum standards for quality and performance.

2.2 DRY-TYPE TRANSFORMERS

- A. General: Transformers shall be high-efficiency dry-type, 2-winding, general purpose, quiet operating, Energy Star compliant. Primary windings shall be equipped with a minimum of two (2) 2-1/2 percent taps above and four (4) 2-1/2 percent taps below rated voltage. Transformer capacity, primary voltage, secondary voltage and phase shall be as shown on drawings.
- B. Insulation: Class H insulation and designed so that transformer temperature rise is not to exceed 150 degrees C rise above a 40 degrees C ambient at full load.
- C. Transformer Core and Windings: Coils shall be vacuum impregnated with non-hygroscopic thermosetting varnish. Windings shall be copper or aluminum.
- D. Sound Levels: Transformers shall be quiet operating and be certified to comply with NEMA Standards. Noisy transformers shall be replaced or remounted to obtain a quiet operation. All units shall be installed on isolation mountings.
- E. Transformer Efficiency: Minimum overall transformer efficiency at 3/4 load shall be as follows:

15 kVA and Below	95.0%
16-60 kVA	95.5%
31-45 kVA	96.0%
46-75 kVA	96.5%
76-150 kVA	97.0%
151-400 kVA	97.5%

2.3 NON-LINEAR TRANSFORMERS

- A. General:

1. Transformer capacity, primary voltage, secondary voltage and phase shall be as shown on the drawings.
 2. Transformer shall be UL Listed for use with nonlinear loads (K-4 rated).
 3. Primary windings shall be provided with two (2) 2-1/2% taps above and four (4) 2-1/2% taps below rated voltage.
 4. Transformer coils shall be of continuous wound copper construction and impregnated with nonhygroscopic thermosetting varnish.
- B. Rating: Transformer insulation shall be a UL recognized 220°C system. Neither the primary nor the secondary temperature shall exceed 220°C at any point in the coils while carrying their full rating on non-sinusoidal load. The maximum temperature "hot spot temperatures" shall not exceed the values state in ANSI/IEEE C57.110 - 1986.
- C. Construction: All cores to be constructed with low hysteresis and eddy current losses. The core flux density shall be well below the saturation point to prevent core overheating caused by harmonic voltage distortion.
1. Transformers shall be common core construction.
 2. The transformer secondary neutral terminal shall be sized for 200% of the secondary phase current.
 3. The transformer enclosures shall be ventilated and fabricated of heavy gauge sheet steel construction. The entire enclosure shall be finished.
 4. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above a 40°C ambient.
 5. The transformer shall be supplied within a separately grounded full width electrostatic shield placed between the primary and secondary windings.
 6. Sound levels shall be guaranteed by the manufacturer not to exceed the following:

15-50 KVA	45 DB
51-150	50 DB
151-300 KVA	55 DB
301-500	60 DB
- D. Standards:
1. All insulation materials are to be in accordance with NEMA ST20 standards for 220°C UL component recognized insulation system. Transformers are to be manufactured and tested in accordance with ANSI Standard C57.12.91 and NEMA ST20.
 2. Transformers smaller shall be listed by Underwriters Laboratory.
 3. Energy Star compliant.
- E. Manufacturer: Square D NL series or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Transformers shall be floor-mounted on 4-inch high concrete pad. Provide vibration isolator pad under each transformer. McDougall Control Co. WMNK series, available from McDougall Control Co., Bellevue, Washington (206) 883-9000.
- B. Provide a minimum of 6" clearance from back/side of transformer to adjacent wall to allow for proper ventilation.

3.2 CONDUIT CONNECTIONS

- A. Provide flexible conduit connections. Every effort shall be made to prevent radiation of noise into adjacent areas of building.

3.3 CABLE CONNECTIONS

- A. Make all cable connections and verify phasing. Check and adjust tap settings as directed by the Owner and ground equipment per NEC.

3.4 MOISTURE

- A. For the entire time prior to installation, transformers must be kept free from moisture, utilizing incandescent lamps within housing or similar methods.

END OF SECTION 26 22 00

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SECTION 26 24 13

SWITCHBOARDS

PART 1 – GENERAL

1.1 SCOPE

- A. Provide switchboards as shown on the drawings and the specification herein.

1.2 SERVICE VOLTAGE

- A. As shown on the drawings.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. General Electric, Square D, Eaton or Siemens. Catalog numbers refer to Square D equipment to establish minimum standards per quality and performance.

2.2 MAIN SERVICE SWITCHBOARD

- A. Construction: Shall be in accordance with NEMA Class II Construction and arranged for dead front indoor installation consisting of free-standing sections 90 inches high, fully barriered with vertical insulated barrier extending full depth of switchboard. Provide horizontal barrier between protective devices and the metering C.T. compartment. All sections shall align. Entire assembly is to be mounted on a 4" concrete pad. All bolts used to join current-carrying parts shall be installed from the front only to make servicing possible without rear or side access. All top, side and front coverplates shall be field removable. Bussing shall be copper or tin-plated aluminum. Switchboard bracing shall be as shown on the drawings.
- B. The switchboard shall be fully bussed allowing full use and expansion for future circuit breaker installation.
- C. Switch board shall have A-B-C type bus arrangement, left-to-right, top-to-bottom, and front-to-rear, as viewed from the front, shall be used throughout.
- D. Ground Bus: Provide continuous and separate neutral and ground busses. Connect to main service ground. Bond each section of switchboard to equipment ground bus.
- E. Main and Feeder Protective Devices: Shall be fixed mounted thermal magnetic type molded case circuit breakers with a minimum interrupting ratings as shown on drawings. The main circuit breaker shall be provided with ground fault protection.

2.3 METERING

- A. Meters monitoring the whole panel and selected feeders shall be integral to the panel, Square D Powerlogic Series or equal. Meter shall have an RS-485 Modbus output with conversion to BACnet MSTP protocol for each monitored load as shown on the drawings. Meter shall include current transformers, terminal blocks, and other parts required for the metering function.
- B. Meters shall monitor the following values:
 - 1. Line-to-neutral voltage for all phases
 - 2. Line-to-neutral average voltage
 - 3. Line-to-line voltage for all phases
 - 4. Line-to-line average voltage
 - 5. Current on each phase
 - 6. Average current
 - 7. Neutral current
 - 8. kVA, kW for all phases, kWh for all phases
 - 9. kW Demand
 - 10. kVAR, kVARh for all phases
 - 11. Power Factor
 - 12. Thd
 - 13. Frequency
- C. Instantaneous values for these parameters shall be accessible via local indications, and through the remote I/O link, equipped with smart communications card.

PART 3 – EXECUTION

3.1 GENERAL

- A. Install all equipment in conformance with manufacture's recommendations.
- B. Provide conduit and cabling to connect pulsed meter output to existing EMS System.

3.2 HOUSEKEEPING PADS

- A. Install switchgear, main service switchboard and distribution switchboards on 4" housekeeping pads. Equipment shall be level and plumb on all sides, grouted and securely bolted to the floor. Extend equipment grounding to cold water main and ground rods as required by the Code. Verify proper operation of each circuit protective device.

3.3 EQUIPMENT ANCHORAGE

- A. All floor mounted equipment shall be securely anchored to slabs.

END OF SECTION 26 24 13

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.1 SCOPE

- A. Provide all required panelboard equipment as shown on the drawings and specified herein.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. General Electric, Square D, Eaton and Siemens. All catalog numbers refer to Square D to establish minimum standards for quality and performance.

2.2 DISTRIBUTION PANELS

- A. 120/208 volt and 277/480 volt, 3 phase, 4 wire. Provide bolt-on circuit breakers and spaces as indicated on the drawings. Circuit breakers shall have a minimum interrupting rating of 22,000 amperes symmetrical. Square D "I-Line" series.

2.3 277/480-VOLT PANELS

- A. 277/480-volt, 3-phase, 4-wire. Provide bolt-on circuit breakers and spaces as indicated on the drawings. Minimum cabinet size: 20 inches wide x 5-3/4 inches deep. Circuit breakers shall have a minimum interrupting rating of 14,000 amperes symmetrical. Square D NF series.

2.4 120/208-VOLT PANELS

- A. 120/208-volt, 3-phase, 4-wire. Provide bolt-on circuit breakers and spaces as indicated on the drawings. Minimum cabinet size: 20 inches wide x 5-3/4 inches deep. Circuit breakers shall have a minimum interrupting rating of 10,000 amperes symmetrical. Square D NQOD series.

2.5 BUSSING

- A. Panelboard bussing shall be copper or tin-plated aluminum.

2.6 SPACE FOR FUTURE CIRCUIT BREAKERS OR FUSED SWITCHES

- A. Provide as indicated on the drawings. Spaces shall be completely equipped for the future addition of a circuit breaker or fused switch, including all mounting hardware and buss connections. Unless otherwise noted, spaces shall be sized to accommodate the following future circuit breaker or fused switch:

<u>Panel Rating</u>	<u>Minimum Space Ampacity</u>
100 amps	70 Amps
225 Amps	125 Amps
400 Amps	250 Amps
600 Amps	400 Amps
800 Amps	600 Amps
1200 Amps	800 Amps

2.7 MULTIPLE-POLE BREAKERS

- A. Shall have common trip with single handle.

2.8 BREAKER LOCK-OFF DEVICES

- A. Lock-off device shall mount on breaker handle to allow pad locking breaker in off position. Provide for breakers noted on drawings or required by Code.

2.9 PANELBOARD CIRCUIT NUMBERING

- A. Odd numbers on left side of panel, even numbers on right.

2.10 IDENTIFICATION

- A. Provide nameplates to identify all cabinets and index cards to identify each circuit in the panelboards.
- B. Label all conductors in panels with circuit number adjacent to the circuit breaker. Utilize plastic sleeve markers. T&B SM series or equal.
- C. Panel designations shall be laminated phenolic plastic with white letters. Provide black background for normal service panelboards and red background for panelboards automatically served by the emergency generator. Refer to Section 26 05 53.
- D. Circuit indexes shall be typewritten and identify locations using the final room numbers established by the Owner, not the room numbers shown on the Architect's floor plan. Indexes are to be located on the inside of each panel door in the space provided. Include a copy of all indexes in the Operations and Maintenance Manual.

2.11 GROUND BUS

- A. Provide one in each panelboard for terminating branch circuit ground conductors and feeder ground conductors. Multiple ground busses utilizing panelboard enclosures for continuity will not be accepted. Burnish area where ground connection is made to panelboard enclosure.

2.12 SPACE ONLY

- A. Means that complete provisions have been made so that only the adding and connection of the circuit breaker will complete the installation.

2.13 CABINETS

- A. All panelboards shall be provided with hinged door construction.
- B. Size of cabinets shall be in accordance with National Electrical Code, minimum size 20 inches wide x 5-3/4 inches deep, or as sized on drawings, sufficiently large to accommodate all equipment and conduit entering the top and bottom. No conduit shall enter sides or back.
- C. Cabinet fronts in finished areas shall be flush type, with smooth face and concealed trim clamps and hinges. Finish shall be ANSI 61 light gray. There shall be no monograms or trademarks visible on the face of the cabinet.
- D. Cabinet doors shall be tight closing without play when latched. Cabinet doors shall have flush retractable latch mechanisms. All cabinets shall be keyed alike.

2.14 METERING

- A. Meters monitoring the whole panel shall be integral to the panel, Square D Powerlogic Series or equal. Meter shall have an RS-485 Modbus output with conversion to BACnet protocol.
- B. Meters monitoring panel feeders shall be stand-alone type in it's own enclosure, Square D Powerlogic E4800 or equal. Meter shall have capacity to separately monitor seven or more individual feeders. Meter shall have an RS-485 Modbus output for each monitored load. Meter shall include current transformers, terminal blocks, and other parts required for the metering function.
- C. Meters shall monitor the following values:
 - 1. Line-to-neutral voltage for all phases
 - 2. Line-to-neutral average voltage
 - 3. Line-to-line voltage for all phases
 - 4. Line-to-line average voltage
 - 5. Current on each phase
 - 6. Average current
 - 7. Neutral current
 - 8. kVA, kW for all phases, kWh for all phases
 - 9. kW Demand
 - 10. kVAR, kVARh for all phases
 - 11. Power Factor
 - 12. Thd
 - 13. Frequency
- D. Instantaneous values for these parameters shall be accessible via local indications, and through the remote I/O link, equipped with smart communications card.

PART 3 – EXECUTION

3.1 MOUNTING

- A. Where panelboards are to be installed against plasterboard walls, provide separate support channels secured to blocking between steel studs. Coordinate blocking work with the Gypsum

Wallboard Contractor. Panels shall not be secured directly to gypsum wallboard material. Unless noted otherwise, mount top of panel at 6' 0" above finished floor.

3.2 CLEAN-UP

- A. After construction is complete, vacuum the interior of all new and existing panel enclosures and provide touch-up paint on factory finished surfaces.

3.3 SPARE CONDUIT

- A. Provide six $\frac{3}{4}$ " spare conduits stubbed into ceiling space from each flush-mounted panelboard.

3.4 TESTING

- A. After all wiring is complete, all feeder and branch circuit terminations shall be checked with a torque wrench. Torque levels shall be in accordance with NETA Standard ATS unless otherwise specified by the Manufacturer. A test report which gives the following information for each panelboard shall be submitted to the Engineer two weeks prior to final inspection:
 - 1. Size and insulation type of the phase, neutral and ground conductors.
 - 2. Phase-to-Phase and Phase-to-Neutral operating load voltage.
 - 3. Operating load current (each phase, neutral and ground).
 - 4. Phase-to-Phase and Phase-to-Neutral conductor insulation resistance. Test shall be made with a DC "Megger" (500V minimum) type tester. If tests indicate faulty insulation (less than 8 megohms) the conductors shall be replaced and retested.
 - 5. A copy of the test report shall be included in the Commissioning Field Notebook and the Operations and Maintenance Manual.
 - 6. Lace all conductors within panelboards utilizing tie-wraps

END OF SECTION 26 24 16

SECTION 26 27 26

WIRING DEVICES

PART 1 – GENERAL

1.1 SCOPE

- A. Provide all wiring devices complete with device plates shown on the drawings or specified within the specifications.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Hubbell, Pass & Seymour, Eaton, or Leviton. All part numbers refer to Hubbell to establish minimum standards for quality and performance.

2.2 GENERAL

- A. All devices shall be specification grade. Color shall be white for normal services and red for all services automatically fed from the emergency generator.

2.3 SWITCHES

- A. Single-Pole: 20-ampere, 120/277-volt, Hubbell No. 1221 Series, white.
- B. Three-Way: 20-ampere, 120/277-volt, Hubbell No. 1223 Series, white.
- C. Four-Way: 20-ampere, 120/277-volt, Hubbell No. 1224 Series, white.
- D. Locking: 20-ampere, 120/277-volt, Hubbell No. 1221L (1-pole)Series or No. 1223L (3-way) series. Provide two keys with each switch. Cover plate shall be stainless steel with on/off labels.
- E. Occupancy Sensor: 277V, 1800W, 900 sq. ft. coverage, passive infrared, white, Hubbell No. WS277I.

2.4 RECEPTACLES

- A. Duplex Receptacles, Specification-Grade: 20-ampere, 125-volt, 2-pole, 3-wire grounding, NEMA Type 5-20R Hubbell No. CR5352I (White Color).
- B. Duplex Receptacles originating from emergency panels, Specification-Grade: 20-ampere, 125-volts, 3-wire grounding. NEMA Type 5-20R Hubbell No. CR5352R (Red Color).

- C. Duplex Receptacles originating from surge protected panels, Specification-Grade: 20-ampere, 125-volts, 3-wire grounding. NEMA Type 5-20R Hubbell No. CR5352GY (Gray Color).
- D. Duplex Receptacles, Tamper Resistant, Specification-Grade: Safety-type, specification-grade device, rated at 20-ampere, 125-volt, grounded type, NEMA Type 5-20R; Hubbell No. SG-62 or approved equal. Receptacles must be capable of accepting double bladed plugs without ground pin.
- E. Ground Fault Interruption Receptacles: Specification grade, 20-ampere, 125-volt, Class A, 5-milliampere sensitivity, standard or feed-through model and as shown on the drawings. Hubbell No. GF 5252 or approved equal.
- F. Controlled Duplex Receptacles, Specification-Grade: 20-ampere, 125-volt, 2-pole, 3-wire grounding, NEMA Type 5-20R, with the two receptacles separately connected and one receptacle marked "controlled" (White Color).
- G. Faceless GFI Module: Specification-grade, 20 ampere, 125 volt, Class A, 5 milliampere sensitivity. Hubbell No. GF53501A or approved equal.
- H. Clock Receptacles: 15-ampere, 125-volt, 2-pole, 3-wire grounding, NEMA type 5-15R clock Hubbell No. 5235.
- I. Weatherproof Receptacles: 20-ampere duplex grounding type, wether resistant, with gasket and hinged metal cover with locking provisions.
- J. Special Receptacles: For other special receptacles, see drawings.
- K. Cord Caps: Cord caps on all cords shall be plastic insulated type.
- L. Cord Reels: Industrial cord reel, white housing, 20A, 120V, 25-foot 12/3 cord, with black portable outlet box and (2) duplex receptacles. Hubbell #HBLI25123R220MI

2.5 SURFACE RACEWAY ASSEMBLIES

- A. Assemblies shall be as manufactured by Wiremold, of type 700, 2000 or 4000 series (including devices) as noted on the drawings. Color shall be ivory.
- B. Provide all required mounting hardware, miscellaneous fittings, end caps, etc. ans manufactured by Wiremold.
- C. One gang device boxes for use with Wiremold 700 product shall be Wiremold part #V5748. Two gang device boxes for use with Wiremold 700 product shall be Wiremold part #V5748-2.
- D. One gang device boxes for use with Wiremold 2000 product shall be Wiremold part #V2048. Two gang device boxes for use with Wiremold 2000 product shall be Wiremold part #V2048-2.
- E. One gang device boxes for use with Wiremold 4000 product shall be Wiremold part #V4007C-1. One gang GFCI receptacle mounting cover for Wiremold 4000 product shall be Wiremold part #V4007C-1R.

2.6 VERITCAL MULTI-OULETS

- A. Free-standing multi-outlet assemblies shall be Walkerduct#5PA 10-4, equipped with single grounded type receptacles.
- B. Each unit shall be equipped with T-bar hangers, carpet or tile pad as required, power fed junction box, and ceiling trim plate.
- C. All receptacles shall be pre-wired (with ground wire) to power fed junction box.
- D. Length of each unit shall be selected to match ceiling height.
- E. Color of unit shall be ivory.
- F. Acceptable Manufacturers
- G. Wiremold equipment which is the approved equal of the equipment specified above is considered acceptable.
- H. Substitutions may be considered only when submitted in conformance with Section 26 05 00.

2.7 DEVICE PLATES

- A. Prohibited materials
- B. Sectional plates shall not be utilized.
- C. All devices shall be equipped with stainless steel 0.04" thick with #302 satin finish, except for audiovisual devices which may be plastic Leviton model.
- D. All junction boxes in finished areas shall be provided with stainless steel plates.
- E. Acceptable Manufactures:
- F. Plates shall be Sierra type, S-Line.
- G. Substitutions may be considered only when submitted in conformance with Section 26 05 00.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install two or more wiring devices shown in one location under a common plate except when outlets are of a different voltages such as telephone and duplex receptacles. Install plates with all edges in continuous contact with finished wall surfaces. Install plates vertically with alignment tolerance of 1/16 inch. Sectional plates are not permitted. No more than one device shall be installed in a single-gang position.
- B. Wiring: Branch circuit conductors shall be terminated either in side of or in back of specification-grade devices with screw clamped terminations. Spring-type pressure connections not approved. Wiring devices are not to be used for maintaining circuit continuity.

Wiring devices are not to be used for maintaining circuit continuity. Removal of wiring device shall not effect downstream devices.

- C. Barrel type key switch shall be used to control lighting in corridors, gyms, cafeterias and restrooms (not required for single occupant restrooms).
- D. Orient receptacles so that ground pin is at bottom, to the right for horizontally-mounted devices. Ground pin at the top is acceptable for switched receptacles.
- E. Outlet height to meet ADA requirements or 16 inches minimum above floor.
- F. Attach surface raceway assemblies to wall surface by method recommended by manufacturer for the particular wall construction. Use anchos similar to Powers Poly-toggle, catalog #2305 with 1-1/2" screw minimum.
- G. Wiremold raceway shall be ivory factory color and shall not be painted. Any raceway attached to the Wiremold product in an unconcealed area which does not come pre-painted from the manufacturer shall properly be prepared for painting and shall be Wiremold #IWE-S ivory spray enamel.

END OF SECTION 26 27 26

SECTION 26 28 13

FUSES

PART 1 – GENERAL

1.1 SCOPE

- A. Provide all fuses shown on drawings and specified herein including spare fuses mounted in a fuse cabinet.

1.2 DESCRIPTION

- A. Provide fuses as indicated on the drawings, sized per NEC, and as required for a fully operational system.
- B. All fuses shall be of the same manufacture.
- C. All fuses shall be installed by the Electrical Contractor at jobsite and only when equipment is to be energized. Fuses shall not be installed during shipment.
- D. Spare Fuse Cabinet: Provide a surface mounted spare fuse cabinet with locking door and shelves. Install within the Main Electrical Room. Provide three spare fuses of each type used on the project.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Bussman, Ferraz Shawmut or Littlefuse.

2.2 FUSES

- A. Provide 200,000 AIC, current limiting, UL, time delay fuses.
- B. Feeders 601-6000 Amps: Class L, KRP-C Time Delay.
- C. Feeders 600 Amps and Less:
 - 1. Class RK-1, LPN-RK for 250-volt, dual element
 - 2. Class RK-1, LPS-RK for 600-volt, dual element.
- D. For motor circuit 600 volts and below: Class RK-1 or Class J sized at 125% FLC of motor.

2.3 FUSE CABINETS

- A. Fuse cabinet shall be of same type and finish as panelboards.
- B. Cabinets shall be sized as required to contain spare fuses. Arrange so fuses are stored on adjustable steel shelves with end of fuse carton exposed when door is open.
- C. Cabinet shall have provisions for installation of directory card of size required to display information described below. Card shall be behind glass cover.

PART 3 – EXECUTION

3.1 SPARE FUSES

- A. At the completion of the project, provide (3) spare fuses of each different type and size used on the project. Any spare fuses utilized during testing must be replaced in order to leave the Owner with the proper amount of spare fuses at completion of the project.
- B. Install fuses in fuse holder with fuse rating visible
- C. Provide typewritten directory card indicating all fusible devices, together with associated fuse size and type.

END OF SECTION 26 28 13

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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 SUBMITTALS

- A. Product Data: Submit for each type of enclosed switch, circuit breaker and accessory being provided.

1.3 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following:
 - 1. Square D
 - 2. General Electric
 - 3. Siemens
- B. The basis of design for this project is Square D. Other manufacturers are acceptable only if their equipment dimensions are equal to or smaller than Square D.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Fusible Switch-600A and Smaller: NEMA KS 1, Type HD with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Nonfusible Switch-600A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

- A. Molded-Case Circuit Breaker: NEMA AB 1 with interrupting capacity to meet available fault currents. Provide with the following features and accessories:

1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
- B. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating. Provide with the following features and accessories:
1. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.

2.4 ENCLOSURES

- A. Rated for environmental conditions at installed locations.
1. Outdoor, wet or damp locations; NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other wet or damp indoor locations; NEMA 250, Type 4.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Control Equipment Mounted to Walls: Mount adjacent units at uniform height. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. Provide freestanding racks complying with Division 26, Section 26 05 29, "Hangers and Supports," for controllers not located on walls.
- B. Floor-Mounted Control Equipment: Anchor to concrete base.
- C. Install fuses in each fusible switch.

3.2 IDENTIFICATION DEVICES

- A. Label each switch and circuit breaker on engraved laminated plastic as specified in Division 26, Section 26 05 53, "Identification."

3.3 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 TESTING

- A. After all wiring to each unit is complete, the Electrical Contractor shall cooperate with the Mechanical Contractor in testing equipment for proper operation and correct wiring as required for proper operation. All connections shall be checked with a torque wrench. Torque levels shall be in accordance with NETA Standard ATS unless otherwise specified by the manufacturer. A test report which gives the following information for each motor shall be submitted to the Engineer two weeks prior to final inspection:

1. All nameplate data (voltage, phase, full-load current, locked motor current, NEMA design, code letter, RPM, etc.)
 2. Measured no-load voltage at motor terminals (all phases)
 3. Measured full-load voltage at motor terminals (all phases)
 4. Full load operating current (all phases)
 5. Motor starter manufacturer and overload heater number (attach the manufacturer's table of overload heater numbers and corresponding motor nameplate ranges)
 6. Fuse size and type
 7. Motor phase-to-phase and phase-to-ground winding resistance (motors five-HP and larger)
- B. A copy of the test report shall be included in the Operations and Maintenance Manuals.

END OF SECTION 26 28 16

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SECTION 26 29 13

ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 MOTOR CONTROLS AND EQUIPMENT CONNECTIONS

- A. Scope: Provide all line voltage wiring and connections to equipment and motors as shown on the plans, diagrams or specified herein. Prior to rough-in Contractor shall obtain all necessary electrical and physical information from the trade providing the equipment and adjust installation requirements as necessary for a complete and operable system.
- B. Motor Controls, Separately Mounted: Provide separately mounted motor starting equipment as shown or noted. Coordinate location and interlocking with Temperature Controls Contractor. Verify motor horsepower size or full-load amperage prior to ordering overload heaters, and size units in accordance with the National Electrical Code.

1.2 OWNER-FURNISHED EQUIPMENT

- A. Provide complete electrical service and connection to all Owner-furnished equipment as shown on the drawings or herein specified, unless indicated otherwise.

1.3 ELEVATOR WIRING

- A. Scope: Provide all line voltage wiring and automatic disconnecting means to elevator equipment as shown on the drawings and as specified herein.
- B. Pit Lighting and Power: Provide light fixture, receptacle and light switch in pit as shown on the drawings.
- C. Elevator Disconnect: Provide surface-mounted elevator fused disconnect switch located as shown on the drawings.

1.4 KITCHEN WIRING

- A. Scope: Provide all wiring for kitchen equipment; connect all equipment; assist the Food Service Equipment Contractor in the testing of equipment after connection.
- B. Coordination: The Electrical Contractor shall coordinate with the Food Service Equipment Contractor to ensure that each item of equipment which requires electrical service is properly connected and wired.

- C. Equipment Wiring: In general, the Food Service Equipment Contractor shall furnish electrical devices and control equipment which are an integral part of the kitchen equipment and will connect all such equipment wiring brought to a single connection point. Electrical control equipment, which is not an integral part of the equipment, will be furnished by the Food Service Equipment Contractor to the Electrical Contractor for mounting and connection, except as noted on drawings. The Electrical Contractor shall provide service connections to each item of equipment; shall mount and connect all control equipment not an integral part of the equipment. The location and method of wiring of control devices shall be ascertained prior to installation.
- D. Conduit Roughing-In: Suit the equipment finally approved for installation and conform to the latest approved shop drawings. All wall-mounted devices shall be flush type.
- E. Exposed Work: All exposed conduits, enclosures and fittings shall be galvanized except for watertight flexible conduit connections.
- F. Connections from Floor: Provide 6' long galvanized rigid conduit screwed into a flush coupling with watertight flexible conduit connection from coupling to the connection point on each piece of equipment. Provide finish type chrome plated escutcheon ring a floor. All connections at floor shall be watertight.
- G. Connections from Wall: Watertight flexible conduit between stainless steel cover plate on outlet box and piece of equipment.
- H. Disconnect Switches: Provide for each piece of equipment as required by code. Disconnect switches shall be placed wherever possible within the equipment at the point of connection. Where this is not practical, the location of the disconnect shall be verified with the Architect. Disconnects shall be molded case circuit breaker. Where mounted on the wall, they shall be flush with chrome plated face plate.
- I. Hood lights: Furnished with hood. Provide conduits connection to the hood light connection point.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Motor starters shall be Cutler-Hammer Advantage series or Siemens. Substitutions may be considered when submitted in conformance with Section 26 05 00.

2.2 MOTOR CONTROLS

- A. Unless noted otherwise, all starters shall include Phase loss and phase unbalance protection.
- B. Manual Starters: Toggle type, with overload protection, NEMA 1 enclosure. Square D Class 2510.
- C. Magnetic Starters: Full voltage, non-reversing, or multi-speed where shown, NEMA 1 (minimum), 3-leg overload protection, 120-volt control, transformer, hand-off-auto switch, red and green indicating lights, 2-N.O. and 2-N.C. auxiliary contacts, Square D Class 8536 Series. Motors 5 HP and larger provide a phase failure/undervoltage relay.

- D. Combination Starters: Full voltage, non-reversing as specified above with integral fused disconnect.
- E. Variable Frequency Drives
 - 1. Motor starters shall be ABB. Substitutions may be considered when submitted in conformance with Section 26 05 00.
 - 2. See Division 23 for complete requirements.
- F. Provide all required relays, wiring, and miscellaneous equipment for Fire Alarm Fan Shutdown compliant with applicable fires codes in conjunction with the site's Energy Management System (EMS). Interconnecting controls shall be rated to match starter control voltage.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Provide shutdown for HVAC equipment through the site's EMS system.

3.2 ISOLATION

- A. All rotating and air handling equipment shall be connected with flexible conduit to provide sound and vibration isolation.

3.3 TESTING

- A. After all wiring to each unit is complete, Electrical Contractor shall cooperate with Mechanical Contractor in testing equipment for proper operation and shall correct wiring as required for proper operation. All connections shall be checked with a torque wrench. Torque levels shall be in accordance with NETA Standard ATS unless otherwise specified by the manufacturer. A test report which gives the following information for each motor shall be submitted to the Engineer two weeks prior to final inspection:
 - 1. All nameplate data (voltage, phase, full load current, locked motor current, NEMA design, code letter, RPM, etc.)
 - 2. Measured no-load voltage at motor terminals (all phases).
 - 3. Measured full-load voltage at motor terminals (all phases).
 - 4. Full load operating current (all phases).
 - 5. Motor starter manufacturer and overload heater number (attach the manufacture's table of overload heater numbers and corresponding motor nameplate ranges).
 - 6. Fuse size and type.
 - 7. Motor phase-to-phase and phase-to-ground winding resistance (motors 5-HP and larger).
- B. A copy of the test report shall be included in the Commissioning Field Notebook and the Operations and Maintenance Manuals.

END OF SECTION 26 29 13

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SECTION 26 51 00

LIGHTING

PART 1 – GENERAL

1.1 OUTLINE OF WORK

- A. Furnish and install all lighting luminaires and related accessories as scheduled herein for the portion of the building to have alterations and for new construction where indicated and as shown on the drawings. All luminaire installations shall be complete with lamps specified.

1.2 RELATED ACCESSORIES

- A. Provide frames, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete installation. Recessed luminaires shall have frames that are compatible with the ceiling systems.

1.3 LABELS

- A. Provide UL labels on all luminaires. Lighting luminaires installed in damp or wet locations in interior or exterior areas shall have label "Suitable for Damp Locations" or "Suitable for Wet Locations."

1.4 MANUFACTURERS' CATALOG NUMBERS

- A. Catalog series numbers specified represent the type and style of luminaire. The size of luminaire shall correspond with the wattage indicated on the luminaire specification sheets or the actual length of the luminaire as indicated on the electrical drawings.

1.5 LAMPS

- A. Provide each luminaire with the number, size and type as required by luminaire or indicated on the drawings. Lamp color shall be 4100K with a color rendering index (CRI) of 82 or better. Each 4' lamp shall have less than 10 mg of mercury where possible. T8 lamps shall be low mercury/non-hazardous and equal to Philips F32T8/TL841/ALTO. Manufacturer shall be General Electric Ecolux, Phillips, Venture, Osram Sylvania or approved equal. All lamps of a specific type are to be of the same manufacturer. There shall be no perceptible color difference between lamps. Compact fluorescent shall have ambient starting temperatures of 23dF for indoor lamps and 0dF for outdoor lamps and have a rated life in excess of 10,000 hours unless otherwise noted.

1.6 BALLASTS

- A. Electronic Fluorescent Ballasts: Ballasts shall be type required for the number and type of lamps in each case. Each luminaire shall have its own ballast. Ballasts shall be HPF - ETL and UL approved. All fluorescent ballasts shall operate at 20 kHz or greater and be Class P thermally protected reset type to meet Section 410-73 (e) of the National Electrical Code and be CSA certified. Ballast factor for all lamp/ballast combinations shall exceed .90 for all cases. Ballast shall comply with FCC requirements under Part 18, Class A. All ballasts shall be guaranteed by the manufacturer for a period of two years after installation. Rapid-start ballasts shall be certified to have an "A" sound rating. The voltage rating of the ballast shall be as required by the service voltage. All Electronic Fluorescent ballasts shall have equal to or less than 10% total harmonic distortion. Manufacturer shall be Advance or Magnetek.
- B. Fluorescent Dimming Ballasts: Refer to Section 26 09 43 Daylight Harvesting for dimming ballasts.
- C. Metal Halide Ballasts: Shall be premium grade, whisper pack, HPF single-lamp type. For 100 watt and above, use constant wattage auto-transformer type. Manufacturer: Advance, Osram, Sylvania, Venture, or Magnetek.
- D. Ballast Service Voltage: Electrical contractor shall be responsible for providing a ballast that matches the service voltage being provided to the luminaire.

1.7 LUMINAIRE SUPPORT

- A. Hangers for Pendant Industrial Luminaires: Luminaires shall be pendant mounted with rigid stems and swivel canopy unless otherwise specified. Provide seismic restraint wires to adjacent structure to prevent horizontal movement.
- B. Safety Hangers: Provide four No. 12 gauge slack wire safety hangers on diagonal corners of each recessed or surface mounted fluorescent luminaire installed on this project. Secure wires to structure above, independent of ceiling system.

1.8 LUMINAIRE ACCESSORIES

- A. Luminaire Lenses: All plastic luminaire lenses are to be pattern 12, minimum 1/8-inch thick, and 100 percent virgin acrylic plastic unless specified otherwise. Manufacture: KSH Plastics or approved equal.
- B. Luminaire Hanging and Mounting Accessories: The Electrical Contractor shall provide all necessary hanging or mounting devices for all luminaires and shall be responsible for checking the type needed for various ceiling conditions. Plaster rings shall be provided where required.
- C. Exterior Light Luminaires: Unless otherwise noted, exterior light poles shall be 20' round spun aluminum. Mount on concrete pole bases as shown on drawings.
- D. Prewired Splice Boxes: Prewired splice boxes for recessed incandescent or compact fluorescent luminaires shall be 4-inch square or equivalent with a minimum of four 1/2-inch knockouts and shall comply with code-required size for branch circuit wiring.
- E. Pre-manufactured Fixture Whips: Fixture whips assembled at the factory may be used to connect recessed light fixtures in accessible ceilings.

1.9 PROPER LIGHTING LUMINAIRE TYPES

- A. Before ordering lighting luminaires, the Electrical Contractor shall be responsible for verifying and coordinating the ceiling systems and lighting luminaire frame requirements as well as the proper ballast voltage.
- B. All fluorescent hinged doors to have beveled aluminum frame with regressed lens design unless specified otherwise.
- C. Provide 6'0" long x 3/8-inch flexible conduit pigtail and outlet box for each luminaire where installed in accessible suspended ceilings.
- D. The luminaire type symbols indicated on the drawings are intended to show the type of luminaire in that particular room or general area. Each individual lighting luminaire shown on the drawings does not necessarily have a luminaire type symbol shown adjacent to it.

1.10 TRADEMARK OR MONOGRAMS

- A. There shall be no visible trademarks or monograms on the lighting luminaires.

1.11 LUMINAIRE CONTINUITY

- A. All fluorescent luminaires of the same general category (i.e., 1x2's, 1x4's, 2x2's, 2x4's, 4x4's) shall be of same manufacture and series to ensure that all lenses and trims match and are compatible in appearance.

1.12 LOCKING CLIPS

- A. Electrical Contractor is to provide and install four locking clips per luminaire for all fluorescent luminaires installed into exposed T-bar ceiling suspension systems. The locking clip is to be attached to the luminaire with a sheet metal screw or similar and secured to the main or supporting T-bar runner to guarantee a secure installation.

1.13 SURFACE MOUNTED LUMINAIRES

- A. Provide surface mounted fluorescent luminaires with UL approval for direct mounting on the various ceilings used. Spacers will not be approved. Where mounted on lay-in ceilings, support luminaires by at least two positive devices which surround the ceiling runner, and which are supported from the structure above by a No. 12 gauge wire. Spring clips or clamps that connect only to the runner are not acceptable.

1.14 FIRE-RATED ENCLOSURES

- A. The Electrical Contractor shall provide 5/8" plasterboard minimum, taped box enclosures for all recessed luminaires in 1- or 2-hour fire-rated ceilings, as required by local building or fire codes. Enclosure to provide minimum 3" air space around luminaire. Electrical Contractor to verify with the Architect areas where this provision is applicable.

PART 2 – PRODUCTS

2.1 LUMINAIRE TYPES

- A. Refer to Luminaire Schedule on the drawings.

2.2 OCCUPANCY SENSORS

- A. Dual Technology with Daylight Sensor: Provide dual technology (infrared/ultrasonic) occupancy sensors in each classroom as noted on the drawings. Switch near door of each classroom is to provide Off-Auto control. When the switch is in the automatic position the occupancy sensors shall turn lights "on" when people are detected within the room. Provide isolated relay output which closes upon sensing occupancy within the room. Wattstopper or approved.
- B. Provide auxiliary dry contacts for remote monitoring as indicated on the drawings.
- C. Provide power packs as required for the occupancy sensor control system.
- D. Provide eight spare occupancy sensors, four spare power packs and four spare slave packs.

PART 3 – EXECUTION

3.1 INSTALLATION OF LUMINAIRES

- A. All luminaires shall be installed exactly level, straight and secure. Ceiling luminaires shall be tight to ceiling.
- B. Luminaires shall be installed per manufacturer's recommendations outlined on the installation instructions. A copy of each luminaire types installation instructions shall be maintained and included in the Operations and Maintenance Manual.
 - 1. Pendant luminaires or similar types where longer runs consist of nominal shorter lengths shall have clean, seamless joints with no visual discontinuity of the housing lines.
- C. Contractor shall not install luminaire lenses, diffusers, or parabolic louvers on luminaires until general construction work is complete, including painting. Dirty lenses, diffusers, or louvers shall be removed, washed and rinsed as recommended by luminaire manufacturer.

3.2 LUMINAIRE SUPPORT

- A. Where luminaires are located so that they cannot be supported by ceiling framing members, the Contractor shall provide additional framing or header bars in ceiling construction as required to support luminaires. Material for luminaire support shall match the ceiling framing material. Luminaires shall be secured to floor slab above or roof structure with a proper hanging device such as lag screw or lag bolt with lead expansion anchor, cinch anchor or stud to support the luminaire plus 100 lbs. at each support. Nails, T-bar clamps or similar fasteners are not approved for lighting luminaire support.

3.3 SEISMIC RESTRAINTS

- A. All pendant-mounted luminaires shall contain horizontal restraints. Provide aircraft cable between luminaire housing and adjacent structure in four directions.

3.4 MOUNTING HEIGHTS OF WALL- AND PENDANT-MOUNTED LUMINAIRES

- A. Mounting heights of pendant-mounted luminaires shown on plans or in specifications shall be to the bottom of the luminaire. Mounting heights of the wall-mounted luminaires shall be to the center of the outlet box unless otherwise noted.

3.5 PENDANT-MOUNTED LUMINAIRES IN CONFLICT WITH DUCTS AND PIPING

- A. Electrical Contractor shall coordinate the location and mounting heights of the lighting luminaires in mechanical rooms with the available space left between the various ducts and piping. Any adverse situation shall be resolved as directed by the Architect.

3.6 FLUORESCENT LUMINAIRES IN ACCESSIBLE TYPE SUSPENDED CEILINGS

- A. If clearance above T-bar system is too restricted to "tip-in" luminaire, the Electrical Contractor shall coordinate with ceiling installer by leaving one cross T-bar off until the cross T-bar may be fitted into place. Fluorescent luminaires installed in hidden-spline type ceilings shall have supporting channels installed by Ceiling Contractor to adequately support the luminaire without providing additional hangers from the structure above the suspended ceiling.

3.7 LUMINAIRE SWITCHING

- A. Lighting luminaires shall be switched as shown on electrical drawings. Unless noted otherwise, three-lamp luminaires shown with 2-level switching shall be wired with lamps 1,3 and 2 each on separate switch-legs for 3-level switching. Four-lamp luminaires shown with 2-level switching shall be wired with lamps 1,4 and 2,3 each on separate switch-legs for 2-level switching.

3.8 EXTERIOR LIGHT LUMINAIRE CONTROL

- A. Exterior lighting shall be EMS (energy management system) controlled. Unless otherwise noted, lighting shall be turned on through the EMS with photo-cell input and turned off through an EMS determined time schedule.

END OF SECTION 26 51 00

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SECTION 27 05 00

SPECIAL SYSTEMS

PART 1 – GENERAL

1.1 SCOPE

- A. Furnish all material, equipment, labor, tools and supervision to provide the complete and functioning special systems for this project as shown on the drawings and specified herein.

1.2 CONTRACT DOCUMENTS

- A. Only equipment devices have been shown on the contract documents. Individual conduits and conductors are not shown on the drawings. Unless specifically specified otherwise, provide complete system wiring to include all conductors installed in conduit raceways between all equipment. Refer to Raceway System Layout, Submittal Requirements.

1.3 SUBMITTALS

- A. See Section 26 05 00, "Electrical, General Provisions," regarding submittal format, copies, etc. The following information is intended to augment those provisions referenced above.
- B. Drawings and Diagrams: Submittals shall contain 1/8-inch = 1-foot-scale floor plans showing all raceway layouts, equipment and devices with complete wire count of all wiring proposed for installation under this contract. All devices shall be numbered and located on the drawings. Provide riser diagrams showing all interconnections and wire types and counts. For clarity, Contractor is encouraged to show wire count in coded form relating to the system or function. Refer to "Raceway System Layout Submittal" for additional submittal requirements. Drawings shall be provided on AutoCAD Release 2002.
- C. Raceway System Layout Submittal: Signal and communication system equipment suppliers shall submit through the Contractor for approval by the Engineer a complete set of reproducible floor plans indicating their proposed raceway routing. Layout shall show all devices and indicate wiring and conduit requirements between all equipment. Floor plans shall consist of reproducible sepia drawings showing only the floor plan and raceway system layout.
- D. Equipment and Materials: Submittals shall contain a complete list of equipment and materials, including manufacturer's descriptive and technical literature, system performance charts, curves and calculations, catalog cuts and installation instructions.
- E. Submit for approval, complete layout of entire fire alarm system showing terminal-to-terminal wiring, all equipment, and complete system operation sequence. This information shall first be submitted for approval to the City of Spokane Fire Department. Sufficient time must be allowed for these approvals prior to ordering equipment and installation of rough-in work.

1.4 QUALITY ASSURANCE/STANDARDS

- A. Requirements: System components and performance must meet Federal Communication Commission Part 76, and National Electrical Code minimum requirements.
- B. License and Bonding: All signal and communications equipment shall be supplied and installed by a licensed and bonded Signal and Communications Contractor holding a valid Washington State Electrical Contractor's License as described in Chapter 19.28, Paragraph 120, of the Electricians and Electrical Installations Revised Code of Washington.
- C. Manufacturer: All major communication system equipment shall be of a single manufacturer, supplied and installed by an authorized factory distributor. Specific system manufacturers are listed under Part 2, "Products," of the Signal and Communication System section.
- D. System Materials: Each special systems contractor shall furnish and install all materials, even though not specifically mentioned herein, which are necessary for the proper integration of the system, so that the system shall perform the functions listed herein in compliance with all the specified requirements.
- E. Experience: Each special systems contractor shall have been regularly engaged in the design and installation of similar systems of equal complexity to the one specified for a period of at least five (5) years.
- F. Authorizations: Each special systems contractor shall have been authorized for a minimum of five (5) years by the manufacturer of the equipment to provide sales, service, and local warranty repairs for the equipment supplied. The special systems Contractor must make all final equipment installation hook-ups, perform testing, place system into proper operation, and provide one-year warranty on portion of system being modified. Selling equipment only for installation, hook-up and warranty by the Electrical Subcontractor will not be allowed.
- G. Installations: Each special systems contractor shall upon request provide evidence of a successful installation of ten (10) similar systems which have been operational for at least twenty four (24) months. The systems shall be in the local market area and available for inspection and demonstration of features.
- H. Financial Resources: Each special systems contractor shall, upon request, be able to illustrate to the satisfaction of the Engineer, that he has sufficient financial resources so as not to endanger in any way, in the sole judgment of the Engineer, full and timely compliance with the documents and specifications.
- I. Service: Each special systems contractor shall maintain a fully equipped service organization with stocks and have direct factory access to the manufacturer's standard parts and be capable of system inspection, troubleshooting, maintenance, and service to the system. Each system contractor shall guarantee availability of 24-hour local service by factory trained personnel of the equipment manufacturer.
- J. Superintendent: During construction and testing, each special systems contractor shall provide a competent superintendent to have full charge of projects of this scope. As a minimum, the supervisor shall have served as installation supervisor for three successfully completed projects. Anyone judged inadequate or non-cooperative by the Engineer shall be replaced immediately. The superintendent shall make himself available to the Engineer.
- K. Responsibility: Each special systems contractor shall accept responsibility for the complete design and installation of the system as described herein.

- L. Prior Approvals: Approval request to prequalify for bidding of equipment not as specified herein must be received by the Engineer not less than ten days prior to bid opening. Proposals shall include but shall not be limited to the following: complete technical data and such samples as required to indicate that the submitted components are equivalent to the specified equipment in all material aspects; the Contractor will itemize on a separate enclosure any variation from the specification (refer to the section, paragraph, and item of the specification and clearly state the variation); a list of similar previous completed projects with the names and telephone numbers of the owners; number of years in the communications business; service staff and qualifications; list of Contractor-owned test equipment; documentation supporting that the Contractor represents the products proposed; and the Contractor's license number. Demonstration of the proposed equipment shall be presented at the Owner's offices at no cost or inconvenience to the Owner's personnel.
- M. Alternative Proposals: Alternative proposals which are approved for bidding purposes only will be published by addenda. Proposals not complying with the prior approval requirements and conditions set forth above will not be considered.

1.5 SCHEDULING AND COORDINATION

- A. Scheduling: Schedule work and location of equipment with other trades to avoid conflict and delays.
- B. Coordination: Coordinate exact location of all devices and equipment with the Architectural drawings before rough-in. Locate all junction boxes and system splices to allow for the easiest possible access by maintenance personnel.

1.6 MAINTENANCE

- A. Maintenance: Any malfunctioning components shall be restored on-site to normal operation within twenty-four (24) hours and shall be replaced with new equipment.
- B. Inventory: Maintain a complete inventory of all parts necessary to provide service according to the specified warranty requirements.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Refer to individual sections (27 13 00 through 28 31 00) for specific system requirements.

2.2 EQUIPMENT GENERAL

- A. All equipment and material shall be new and the standard products of one manufacturer supported by a local service organization and shall be listed by Underwriters' Laboratories, Inc. or Factory Mutual Insurance Corporation.

PART 3 – EXECUTION

3.1 RACEWAYS AND WIRING

- A. Requirements: All wiring shall be run in continuous metallic raceways unless specified otherwise. See Section 26 05 33 and 26 05 40 for raceway and outlet box requirements.
- B. Wiring: Provide complete wiring per manufacturer's requirements in conduit, as specified for lighting and power. Conductors shall be copper. The Contractor shall verify all wiring requirements with manufacturer prior to submitting a bid. Wiring in raceways shall not exceed 40 percent conduit fill
- C. Raceways: Only equipment devices have been shown on the Contract Documents. Individual conduits and conductors are not shown on the drawings. Unless specifically specified otherwise, Contractor shall provide complete wiring system to include all conductors installed in metallic-conduit raceways between all equipment shown and specified herein with quantity and size of conductors and raceways as determined by the equipment manufacturer.
- D. Raceway System Layout Submittal: Equipment supplier shall submit for approval to the Engineer through the Contractor a complete set of floor plans in the quantity as required by Submittal Section 26 05 00, indicating their proposed raceway routing. Layout shall show all devices and indicate wiring and conduit requirements between all equipment. Floor plans shall consist of drawings showing only the floor plan and raceway system layout.
- E. Splices: No splices shall be installed in conduit or any inaccessible place. All splices shall be made on terminal blocks specifically designed for that purpose. All terminations must be identified.
- F. Color Coding: All cabling and wiring shall have jacket colors as follows:
- G. Telecommunications: Non-plenum – Blue; Plenum – White
- H. Intercom/Clock: Gray
- I. EMS: White
- J. TV: Black
- K. Security: Yellow
- L. Rack Wiring: Wiring within signal/communications equipment racks and cabinets is to be accomplished using telephone rack wiring techniques reflecting the highest professional standards. All wiring shall be consolidated and laced. All corners shall be squared and tie downs employed. Fabrication work not meeting these standards will be unacceptable. All conductors must be identified with wire markers that relate to the system shop drawing.

3.2 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide operations and maintenance manuals in accordance with Section 26 05 00, "Electrical, General Provision," of the specification.
- B. In addition to the requirements of Section 26 05 00, "Electrical, General Provision," the following shall be provided:

1. Shop drawings showing the "as-built" locations of all components, conduit runs and cables utilized. Refer to "Record Drawings" in Section 26 05 00, Electrical, General Provisions" for additional requirements.
2. Certified results of all systems tests.

3.3 LABEL AND IDENTIFICATION

- A. Equipment Cabinets: Identify signal and communications systems equipment cabinets with an engraved phenolic plastic nameplate as described in Section 26 05 53 "Electrical Identification"
- B. Junction Boxes: Refer to Section 26 05 40. Mark covers of all concealed signal and communications systems junction boxes with a distinctive letter and color using a permanent label or marker. All fire alarm system wiring shall utilize red color.
- C. Wiring: Identify both ends of each wire with room number or location of component to match identification or wiring diagram. Wire markers shall be located adjacent to connection point here easily visible. Marking system shall be Brady IDPro Printer with WML-311-292 labels or approved equal. Wires and cables for the Energy Management System (EMS) shall have labels with black letters on orange background using Brady #42039 tape and #42011 ribbon.
- D. Testing and Acceptance
- E. Start-Up: The Communication System Contractor shall be responsible for the start-up, commissioning, and troubleshooting of the signal and communications systems. Notify the Owner, Architect and Engineer of the date and time of commission testing at least two weeks prior to testing. The Owner may elect to have the testing witnessed by their personnel or an authorized representative. Start-up and testing of the system by the Electrical Subcontractor is not acceptable.
- F. Test Results: Upon completion of the testing, the completed test documentation shall be sent to the Architect stating that the adjustment and commissioning of the system is complete. A copy of each test shall be included in the Operations and Maintenance Manual.
- G. Deficiencies: In the event that defects or deficiencies are found, they are to be corrected to the satisfaction of the Architect.
- H. Acceptance: Signal and communications systems will not be accepted on a device-by-device or area-by-area basis, but only as a fully completed and operational system. Beneficial usage shall start upon successful completion of the system test and acceptance by the Owner.

3.4 TRAINING

- A. General: Each manufacturer's representative is to include sufficient hours in this bid to cover the cost of fully instructing the Owner or his designated representatives in the use and operation of each system. This shall include 8 hours training on the Fire Alarm System and 8 hours training on the Intercom and Master Clock System.
- B. Training: Orient the training specifically to the systems installed, rather than a general training course. Instructors shall be thoroughly familiar with all aspects of the specific system and its components.

3.5 PROVISIONS

- A. Provide the training necessary to ensure competence in the operation of the system by the personnel. Provide instructors, literature, and necessary equipment to train the personnel.

END OF SECTION 27 05 00

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATION SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. Grounding and bonding systems are an integral part of the signal or telecommunications cabling system. In addition to helping protect personnel and equipment from hazardous voltages, a proper grounding and bonding system will improve the electromagnetic compatibility performance of the cabling system. Improper grounding and bonding can allow induced voltages and conducted noise, which can disrupt signal transmission. The telecommunications grounding and bonding system shall conform to local codes and EIA/TIA - 607-B requirements.
- B. Description of work:
 - 1. Furnish and install a complete and fully-functioning grounding and bonding system. All cables, terminations, support hardware, and grounding and bonding hardware shall be furnished, installed, tested, labeled, and documented by the telecommunications subcontractor.
 - a. Coordinate with electrical contractor including pathways, termination points, busbar locations, and connections to the main electrical service ground and electrical distribution panels.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS

- A. BCT: Bonding Conductor for Telecommunications. A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground.
- B. Bonding: The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.
- C. EMT: Electrical metallic tubing.
- D. GE: Grounding equalizer. The conductor that interconnects elements of the telecommunications grounding infrastructure. For example, a bonding conductor that interconnects TGBs on the same floor.
- E. Ground: A conducting connection, whether intentional or accidental, between an electrical circuit (e.g. telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.

- F. RGC: Rack Bonding Conductor. A bonding conductor used to connect an equipment rack directly to the TMGB or TGB.
- G. RGB: Rack Bonding Busbar. A busbar that is vertically mounted on an equipment rack.
- H. TBB: Telecommunications bonding backbone. A conductor that interconnects the telecommunications main grounding busbar (TMGB) to the telecommunications grounding busbar (TGB) located on the floor farthest away.
- I. TGB: Telecommunications grounding busbar. A common point of connect for telecommunication systems and equipment bonding to ground and located in the telecommunications rooms (TR) and equipment room (ER).
- J. TMGB: Telecommunications main grounding busbar. A busbar placed in a convenient and accessible location and bonded, by means of the BCT, to the building ac service equipment (power) ground.

1.4 SUBMITTALS

- A. The following submittals are due at the Pre-Construction Phase, in accordance with submittal requirements in Section 270500 "Special Systems":
 - 1. Product Information
 - a. Provide table of contents with all product names, manufacturer, and specific product number identified to accompany manufacturer cut-sheets.
 - b. Provide manufacturer's product information cut-sheet or specifications sheet with the specific product number identified.
 - 2. Shop Drawings
 - a. Provide scaled drawings (floor plans not less than 1/16" = 1'-0") indicating the location and size, dimensions, type of connection (e.g. mechanical, exothermic weld of each bonding busbar (e.g., TMGB, TGB), conductor (e.g., BCT, GE, TBB), connections (e.g., lugs), and splice points.
 - b. Provide scaled plan and elevation drawings of telecommunications rooms (not less than 1/4" = 1'-0") indicating locations of busbars (e.g. TMGB, TGB, RGB).
 - c. Bonding and Grounding shall have its own separate drawing(s).
- B. The following submittals are due at the Post-Construction Phase, in accordance with submittal requirements in Section 270500 "Special Systems":
 - 1. Record Drawings
 - a. Provide scaled drawings (floor plans not less than 1/16" = 1'-0") indicating actual location and size/length of TMGB, TGBs, BCT, GE and TBB conductors and all splice points.
 - b. Provide scaled plan and elevation drawings of telecommunications rooms (not less than 1/4" = 1'-0") indicating actual locations of TMGB and TGBs.
 - c. Bonding and Grounding shall have its own separate drawing(s). Provide manufacturer's product information cut-sheet or specifications sheet with the specific product number identified.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All components shall be Listed by a NRTL.
- B. Telecommunications grounding systems shall conform to EIA/TIA-607-B and the following guidelines, whichever is more stringent.

2.2 CONDUCTORS

- A. Conductors shall be copper. Bare and insulated conductors are permitted. The NEC specifies criteria for mechanical protection.
- B. Conductors shall comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG and no longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor
 - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 COMPRESSION LUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following or an approved equal:
 - 1. Harger Lightning and Grounding
 - 2. Hubbell
 - 3. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
 - 4. Compression Type

5. Two holes with various hole spacing's to fit the busbar.
6. Long barrel that will allow a minimum of two crimps with standard industry colors.
7. An inspection window to verify that the conductor is fully seated in the lug.
8. Crimped according to manufacturer's recommendation.

2.4 TAPS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following or an approved equal:
 1. Harger Lightning and Grounding
 2. Hubbell
- B. Connections to the conductor shall be made with irreversible compression connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- C. Shall be able to accept 6 AWG to 3/0.
- D. Shall require a minimum of two (2) crimps for C Tap and H Tap, one (1) crimp for I-Beam and busbar Tap.
- E. Crimp according to manufacturer's recommendation.
- F. C Tap
 1. Main Run 6-4 AWG - Tap 6 AWG
 - a. Hubbell Part Number HYC4C6
 2. Main Run 6-4 AWG – Tap 4 AWG
 - a. Hubbell Part Number HYC4C4
 3. Main Run 2 AWG – Tap 8-4 AWG
 - a. Hubbell Part Number HYC2C4
 4. Main Run 2 AWG – Tap 2 AWG
 - a. Hubbell Part Number HYC2C2
 5. Main Run 1/0-2/0 AWG – Tap 8-2 AWG
 - a. Hubbell Part Number HYC26C2
 6. Main Run 1/0-2/0 AWG – Tap 1/0-2/0 AWG
 - a. Hubbell Part Number HYC26C26
- G. H Tap
 1. Main Run 4/0-2 AWG - Tap 2-8 AWG
 - a. Hubbell Part Number HYH292C
 2. Main Run 2-8 AWG – Tap 2-8 AWG
 - a. Hubbell Part Number HYH2C2C
 3. Main Run 6-10 AWG – Tap 6 AWG
 - a. Hubbell Part Number HYH6C6C

H. Busbar Tap

1. Busbar thickness 0.25", Main Run 2 AWG - Tap 6 AWG
 - a. Hubbell Part Number HYG14B2TC2C6C
2. Busbar thickness 0.25", Main Run 2 AWG – Tap 2 AWG
 - a. Hubbell Part Number HYG14B2TC2C2C
3. Busbar thickness 0.25", Main Run 4/0 – 1/0 AWG
 - a. Hubbell Part Number HYGBTC28

2.5 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following or an approved equal:
1. Harger Lightning and Grounding.
 2. Hubbell
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4-inch by 4-inches in cross section and at minimum 20-inches long. Increase length as necessary to provide all connections with 25% spare capacity. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-B (Harger P/N GBI14420TMGBKT or equal).
1. A TMGB shall be provided at the telecommunications service entrance (or as indicated on the drawings).
 2. Predrilling shall be with holes for use with lugs specified in this section.
 3. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 4. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000V.
- C. TGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4-inch by 2-inch in cross section and at minimum 12-inches long. Increase length as necessary to provide all connections with 25% spare capacity. The busbar shall be NRTL listed for use as TGB and shall comply with J-STD-607-B (Harger P/N GBI14212TGBKT or equal).
1. A TGB shall be provided in each telecommunications room.
 2. Predrilling shall be with holes for use with lugs specified in this section.
 3. Mounting Hardware: Stand-off brackets that provide a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 4. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-B. Predrilling shall be with holes for use with lugs specified in this section.
1. Rack-Mounted Vertical Busbar: Minimum 36-inches long with stainless-steel or copper plated hardware for attachment to the rack.

2.6 LADDER RACK BONDING CONDUCTORS

- A. Ground cord assembly
 - 1. Stranded THHN
 - 2. Color: green
 - 3. #6 AWG insulated bonding jumper
 - 4. Length: 9" - 12".
 - 5. Each end terminated with a two hole compression lug or listing approved terminal
 - 6. Hubbell Part Number HGRKTD12D, HGRKTKA9KA5, HGRKTKLU9KLU5

- B. Braided Jumper
 - 1. 0.94" Braid width
 - 2. Hole diameter 0.375"
 - 3. Hole Spacing 1.25"
 - 4. Length: 12"
 - 5. Hubbell Part Number HGBBD12

2.7 BASKET TRAY CONDUCTORS

- A. Mounts to the basket tray metal runner
- B. Accepts #6 AWG cable that spans the gaps between sections of basket tray
- C. Hubbell Part Number HGBKS17, HGRKTWC45, HGRKTWB5

2.8 LABELING

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8-inch. Overlay shall provide weatherproof and UV-resistant seal for label.

PART 3 – EXECUTION

3.1 GENERAL

- A. Locate TMGB and TGBs so that they are accessible to telecommunications personnel.
- B. At a minimum, follow all manufacturer instructions. In case of discrepancy between manufacturer and contractor requirements, the more stringent shall apply. In the case of conflicting instructions, report any discrepancy to the Design Engineer in a timely fashion so as not to impact the construction timeline.
- C. At a minimum, provide exothermic welds as identified on the drawings or required in the specifications. For all other connections, irreversible compression connections are sufficient.

3.2 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1
- C. Comply with J-STD-607-B

3.4 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare-copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of no more than 36 inches.
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend shall exceed 90 degrees.
 - 2. Install without splices.
 - 3. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room, supporting the 3/4-inch PVC at intervals of no more than 36 inches. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

- a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a ground bushing that complies with requirements in Section 27 05 28 'Pathways for Communications Systems,' and bond both ends of the conduit to a TGB.

3.5 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 AWG. The BCT shall be, as a minimum, the same size as the largest TBB.
- B. The TBB between the TMGB and the farthest TGB shall be a continuous copper conductor that should be sized no less than 6 AWG to a maximum 3/0 AWG. This conductor shall be sized per Table 1 below:

TBB Conductor Size vs. Length	
TBB/GE linear length (ft.)	TBB/GE size (AWG)
Less than 4	6
14-20	4
21-26	3
27-33	2
34-41	1
42-52	1/0
53-66	2/0
Greater than 66	3/0

Table 1 - TBB Conductor Size vs. Length

- C. The GE between TGBs on the same floor on the first, top, and every third floor in a multistory building shall be a continuous copper conductor that should be size no less than 6 AWG. The GE shall be, as a minimum, the same size as the largest TBB.
- D. The Telecommunications Equipment Bonding Conductor (TEBC) shall be a continuous copper conductor that should be sized no less than 6 AWG.

3.6 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, in insulated spacers 2 inches minimum from wall, 12 inches minimum above finished floor unless otherwise indicated.
- B. The TMGB shall be installed at the bottom of the backboard near the building entrance conduits in the EF.
- C. Each TGB shall be installed at the bottom of the backboard near where the TBB enters or passes through each TR.
- D. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.7 CONNECTIONS

- A. Bond metallic equipment in a telecommunications entrance facility, equipment room and telecommunications rooms to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with the manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pre-twist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications bonding backbone conductor. If more than one TMGB is installed, interconnect TMGBs using grounding equalizer conductor. The telecommunications bonding backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertical rack equipment grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB using No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in telecommunications rooms and spaces. Comply with TIA-568-C.0 when grounding screened, balanced, twisted pair cables.
- J. Rack- and Cabinet-Mounted Equipment: bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as supplement to bonding requirements in this Section.
- K. Access Floors: Bond all metal parts of access floors to the TGB.
- L. Equipment room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
 - 1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
 - 2. Bond the TGB of the equipment room to the reference grid at two or more locations.
 - 3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

- M. Cable runways and Cable Trays: In order to achieve the objectives of potential equalization, ensure that the all cable runway and cable tray sections are bonded together and bonded back to the TMGB/TGB using two-hole compression lugs or ground terminal blocks. Listed split bolts suitable for the application can be used for bonding sections of cable runways or trays. Cable runway/tray bonding conductors shall be installed between every splice junction of runway/tray to ensure electrical continuity. Consult cable runway/tray manufacturers for recommended grounding and bonding requirements.

3.8 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.
- D. Grounding Connections to Manhole Components: bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections. Tests shall be performed by the contractor and the designer/consultant shall perform the inspections.
- B. Tests and Inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Test the bonding connections of the system using an AC earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB or a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms (0.1 ohm).
 - b. A copy of the test results shall be provided to the Electrical Engineer prior to any telecommunication services being activated.
 - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

- a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1.0 A.

- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify the Electrical Engineer promptly and include recommendations to reduce ground resistance.

- D. Grounding system will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports and provide to Electrical Engineer.

END OF SECTION 27 05 26

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SECTION 27 05 33

CONDUITS AND BACK BOXES FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. This section governs the products and installation of conduits, back boxes, and additional accessories, connections, fittings, and equipment required for in-building communications systems, otherwise known as “Electrical Rough-in”.

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS

- A. Conveniently Accessible – being capable of being reached from the floor or use of 8-foot step ladder without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and duct work.
- B. IMC – Intermediate Metal Conduit
- C. Listed Communications Cable – A cable listed by a Nationally Recognized Testing Laboratory (NRTL) and acceptable to the local Authority Having Jurisdiction (AHJ) as having met appropriate designated standards or has been tested and found suitable for installation in specific spaces. Refer to NEC Articles 725, 770, and 800 for listing types and additional requirements. Assume Outside Plant (OSP) Cables being supplied are not Listed.
- D. Plenum – A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
- E. Plenum-rated – A product that is Listed by a NRTL as being suitable for installation into a plenum space. Communications cabling shall be Listed and identified as type CMP.
- F. Point of Entrance (Building Entrance) – The point within a building at which the OSP communications wire or cable emerges from an external wall, from a concrete floor slab, or from a rigid metal conduit (Type RMC) or an intermediate metal conduit (Type IMC) connected by a grounding conductor to an electrode in accordance with the NEC.
- G. RMC – Rigid Metal Conduit
- H. UL – Underwriters Laboratory

1.4 SUBMITTALS

- A. The following submittals are due at the Pre-Construction Phase, in accordance with submittal requirements in Section 27 05 00 Special Systems:
1. Product Information
 - a. Provide table of contents with all product names, manufacturer, and specific product number identified to accompany manufacturer cut-sheets.
 - b. Provide manufacturer's product information cut sheet or specifications sheet with the specific product number identified or filled out.
 2. Shop Drawings
 - a. Provide scaled drawings (not less than 1/8" – 1'-0") indicating routing of conduits and locations of all pull points (to include pull boxes, communications LB, etc.). These locations are to be fully coordinated with all other trades.
- B. The following submittals are due Post-Construction, in accordance with submittal requirements in Section 27 05 00 Special Systems:
1. Record Drawings
 - a. Provide scaled drawings (not less than 1/8" = 1'-0") indicating actual installed routing of conduits and locations of all pull points. Design or shop drawings modified in the field will not be accepted.
 2. Keys for any pull boxes (if applicable)

PART 2 – PRODUCTS

2.1 GENERAL

- A. Refer to Electrical specifications for additional information.

2.2 CONDUIT

- A. Refer to execution section for sizing and installation requirements.
- B. Refer to Electrical specifications for list of approved manufacturers.
- C. The minimum conduit trade size for telecommunications shall be 1-inch.

2.3 BACKBOXES

- A. At minimum, the typical communications backbox shall be 4-11/16-inch square by 2-1/8- inch deep with 1-1/4-inch knockouts and a 4-11/16-inch Square Mud-Ring for one (1) device (single-gang) unless noted otherwise.
1. For outlets in stud wall, Manufacturer shall be:
 - a. RACO/Hubbel Electrical Products – 4-11/16-inch Square Box, 2-1/8-inch Deep, 1-1/4-inch Side Knockouts. (P/N RACO259) with 4-11/16-inch Square Mud-Ring for one (1) device (verify appropriate Mud-Ring depth).

- b. Randl Industries, Inc. – 5-square Telecommunications Outlet Box (P/N T55017) with appropriate mud-ring.
 - c. Or approved equivalent.
2. For outlets in CMU wall, submit appropriate backbox for application.
 3. For outlets above ceiling for applications such as Wireless Access Points
 - a. Grainger Single-gang Galvanized Steel Box (P/N 2DDB6) with Grainger 3/4" nipple (P/N 1UGX5), two (2) Grainger 3/4" lock nuts (P/N 5XC31) and a Grainger 3/4" plastic bushing (P/N 5XC35).
 - b. Or approved equivalent.

2.4 PULLBOXES

- A. Material shall be aluminum or steel.
- B. The following manufacturers are conditionally-approved:
 1. Hoffman
 2. Or approved equivalent
- C. Refer to execution section for sizing and installation requirements.

PART 3 – EXECUTION

3.1 GENERAL

- A. Contractor shall follow all manufacturer's instructions.
- B. Coordinate with all other trades prior to installation.

3.2 CONDUIT

- A. Conduit size to telecommunications outlets shall be minimum trade size 1-inch unless otherwise noted.
- B. Conduits which enter Telecommunications Spaces shall extend:
 1. 4-inches above finished floor, or
 2. 3-inches below finished ceiling, or
 3. 3-inches through wall
- C. Conduits shall be reamed and bushed.
- D. Telecommunications building entrance conduits shall be RMC or IMC construction and shall extend to within 50-foot cable length from the location reserved for Building Entrance Protection in the Entrance Facility.
- E. Minimum Bend Radius
 1. For trade size conduits 2-inches or less, maintain a minimum bend radius of six (6) times the actual inside diameter of the conduit.

- 2. For trade size conduits greater than 2-inches, maintain a minimum bend radius of ten
- 3. (10) times the actual inside diameter of the conduit.

- F. No continuous section of conduit may exceed 100-feet. Utilize pull boxes as necessary.

- G. No continuous section of conduit may include more than two (2) 90 degree bends (or equivalent).

- H. Conduit to Floor Boxes in Slab-on-Grade
 - 1. Slab-on-grade conduits shall not be installed.

- I. Flexible Conduit
 - 1. As defined by the NEC.
 - 2. To be utilized only at specific locations identified on the drawings and previously approved by the Engineer or Owner prior to installation.
 - 3. Sections are to be limited to a maximum of 20-feet in length and the trade-size shall be increased by one. The minimum trade size shall be 1-inch unless otherwise noted and approved.

3.3 BACKBOXES

- A. Back boxes installed into fire-rated walls shall include appropriate fire-stopping system.

- B. Where back-to-back with outlet on opposite side of wall, off-set one of the back boxes and conduits to adjacent stud cavity or masonry block.

3.4 PULLBOXES

- A. Angle, U-pulls, or Directional changes within a pull box shall not be allowed.

- B. Straight Pulls. In straight pulls, the length of the box shall not be less than eight (8) times the trade size of the largest conduit.

- C. For Straight Pulls, size pull boxes according to the following table:

Conduit Trade Size	Min. Width	Min. Length	Min. Depth	Width Increase for Additional Conduit
1"	4"	8"	3"	2"
1-1/4"	6"	10"	3"	3"
1-1/2"	8"	12"	4"	4"
2"	8"	16"	4"	5"
2-1/2"	10"	20"	6"	6"
3"	12"	24"	6"	6"
4"	16"	32"	8"	6"

- D. Install pull boxes in conveniently accessible locations.

END OF SECTION 27 05 33

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SECTION 27 05 36

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. This section governs the products and installation of cable trays and additional accessories, connections, fittings, and equipment required for in-building communications systems.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 270500 “Special Systems” including all referenced codes, standards and guidelines.

1.3 QUALITY ASSURANCE

- A. All cable trays, including all parts, pieces and connections, shall be certified from a NRTL for the intended purpose.

1.4 SUBMITTALS

- A. The following submittals are due prior to beginning construction, in accordance with the submittal Requirements in Section 270500 “Special Systems”.
 - 1. Product Information
 - a. Provide table of contents with all product names, manufacturer, and specific product number identified to accompany manufacturer cut-sheets.
 - b. Provide manufacturer’s product information cut sheet or specifications sheet with the specific product number identified or filled out.
 - c. Include documentation from manufacturer that the cable tray system has been UL-tested to be continuously grounded.
 - d. Where the desired distance between cable tray supports is greater than 5-feet, provide calculations indicating maximum distance given the worst case load factor for the area with the greatest density of cables.
 - 2. Shop Drawings
 - a. In conjunction with horizontal and backbone cable routing, provide scaled drawings (not less than 1/8”=1’-0”) indicating routing of cable and means of support (where supported by cable tray versus j-hooks). These locations are to be fully coordinated with other trades.
 - b. Where submitted locations of cable trays differ from those in the contract documents, note the shop drawings with the reason for the relocation.
- B. The following submittals are due Post-Construction, in accordance with the submittal Requirements in Section 270500 “Special Systems”.

1. Record Drawings
 - a. In conjunction with horizontal and backbone cable routing, provide scaled drawings (not less than 1/8" = 1'-0") indicating routing of cable and means of support. Design drawings or shop drawings modified in the field will not be accepted.
2. Manufacturer and Maintenance Manuals for all installed equipment.
 - a. Provide manufacturer's product information cut sheet or specifications sheet with the specific product number identified or filled out.
 - b. List of bill of materials, including all parts, pieces and connectors required for installation of the cable tray system.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 1. Source Limitations: Obtain cable trays and components from single manufacturer.
 2. Sizes and Configurations: As noted on the Drawings.
- B. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 3. Load and Safety Factors: Applicable to both side rails and run capacities.
- C. The cable tray system shall be Listed for its location and intended purpose.
- D. The cable tray system shall be Listed to allow for continuous grounding. Refer to execution section for additional grounding requirements.

2.2 LADDER CABLE TRAYS

- A. Location: Telecommunication equipment rooms (E.g. MDF)
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Chalfant Manufacturing Company.
 2. Cooper B-Line, Inc.
 3. Mono-Systems, Inc.
 4. MP Husky.
- C. Description:
 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
 2. Rung Spacing: 9 inches on center.
 3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.

4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
7. Minimum Useable Load Depth: 3 inches minimum.
8. Straight Section Lengths: 10 feet except where shorter lengths are required to facilitate tray assembly.
9. Width: 12 inches unless otherwise indicated on Drawings.
10. Fitting Minimum Radius: 12-inches
11. Splicing Assemblies: Bolted type using serrated flange locknuts.
12. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316 or Steel, zinc plated according to ASTM B 633
13. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.3 WIRE-BASKET CABLE TRAYS

- A. Location: All spaces other than telecommunication equipment rooms (E.g. MDF)
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Cablofil/Legrand.
 2. Cooper B-Line, Inc.
- C. Description:
 1. Configuration: Wires are formed into standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
 2. Materials: High-strength-steel longitudinal wires with no bends.
 3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
 4. Sizes:
 - a. Straight sections shall be furnished in standard 10-foot lengths.
 - b. Wire-Basket Depth: 2-inch usable loading depth by 6 inches, 12 inches, 18 inches or 24 inches wide.
 - c. Wire-Basket Depth: 4-inch usable loading depth by 12 inches, 18 inches or 24 inches wide.
 5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
 6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 7. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316 or Steel, zinc plated according to ASTM B 633.

2.4 SINGLE-RAIL CABLE TRAYS

- A. Single-Rail Cable Trays are prohibited.

2.5 TROUGH CABLE TRAYS

- A. Trough Cable Trays are prohibited unless otherwise noted.

2.6 FIBERGLASS CABLE TRAY

- A. Fiberglass Cable Trays are prohibited.

2.7 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Covers: Covers are not required unless otherwise indicated.
- C. Barrier Strips: Same materials and finishes as for cable tray.
- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.8 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE1.

PART 3 – EXECUTION

3.1 GENERAL

- A. Minimum clearances for cable tray:
 - 1. Maintain as much separation from EMI sources as practical. At minimum, cable tray shall be installed at least:
 - a. 6-inches away from fluorescent light fixtures.
 - b. 6-inches away from power lines (circuits) enclosed in a grounded metal conduit.
 - c. 48-inches away from electrical motors and transformers.
 - 2. Install a minimum of 3-inches above accessible ceiling T-bars. If possible, install 6-inches above accessible ceiling T-bars.
 - 3. Install with 12-inches of open space above and to one side of the tray to allow access for installing and maintain cable.
 - a. Coordination with other trades is imperative. It shall be the contractors responsibility to coordinate and ensure all ductwork, piping, etc. of other trades is installed to allow successful installation of cable tray.
 - 4. Where minimum clearances are not possible, project must reroute cable tray at no cost to the Owner.
 - a. Cable tray may be relocated at the contractors discretion, provided that it is within the footprint of the same room(s) as indicated on the construction drawings, and the contractor notes the new routing on the Record Drawings.

- b. Where cable tray needs to be relocated above different room(s) than indicated on the construction drawings, contractor shall submit an RFI with proposed new location.

3.2 CABLE TRAY INSTALLATION

- A. Install cable trays in all corridors and hallways.
- B. Cable trays shall not be installed above individual offices, conference rooms or restrooms.
- C. Install cable trays according to NEMA VE 2.
- D. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- E. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- F. Remove burrs and sharp edges from cable trays.
- G. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- H. Fasten cable tray supports to building structure.
- I. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb.
- J. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- K. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- L. Support bus assembly to prevent twisting from eccentric loading.
- M. Center-hung supports are prohibited.
- N. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
- O. Support wire-basket cable trays with trapeze hangers or wall brackets as required by application.
- P. Support trapeze hangers for wire-basket trays with 3/8-inch diameter rods.
- Q. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

- R. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- S. Make changes in direction and elevation using manufacturer's recommended fittings.
- T. Make cable tray connections using manufacturer's recommended fittings.
- U. Seal penetrations through fire and smoke barriers. Comply from requirements in Section 270545 "Penetration Fire-stopping for Communications Systems."
- V. Install capped metal sleeves for future cables through fire-stop-sealed cable tray penetrations of fire and smoke barriers.
- W. Install cable trays with enough workspace to permit access for installing cables.
- X. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15000 V.
- Y. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- Z. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

3.3 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified.
- B. Cable trays with communications cable shall be bonded together with splice plates listed from grounding purposes or with listed bonding jumpers.
- C. Cable trays with control conductors shall be bonded together with splice plates listed from grounding purposes or with listed bonding jumpers.
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.4 CABLE INSTALLATION

- A. Install cables only when each cable tray has been completed and inspected.
- B. Fasten cables on horizontal runs with Velcro ties. Tighten Velcro only enough to secure the cable, without indenting the cable jacket.
- C. Fasten cables on vertical runs to cable trays every 36 inches.

- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. Install cable waterfalls when cables exit the tray. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.
- E. In existing construction, remove inactive or dead cables from cable trays.

3.5 CONNECTIONS

- A. Remove paint from all connection points before making connections. Repair paint after all connections are completed.
- B. Connect pathways to cable trays according to requirements in NEMA VE 2.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with an Owner representative present:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and re-torque in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

3.7 PROTECTION

- A. Protect installed cable trays and cables.
 - 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be construction of wood or metal materials and shall remain in place until the risk of damage is over.

2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 27 05 36

SECTION 27 05 45

PENETRATION FIRE-STOPPING FOR COMMUNICATIONS SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. This section shall govern the products and installation of all necessary parts, pieces and accessories of a UL Listed penetration fire-stopping system for communication systems.
- B. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

1.2 RELATED DOCUMENTS

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

1.3 REFERENCES

- A. ASTM E 84, "Surface Burning Characteristics of Building Materials".
- B. ASTM E 119, "Fire Tests of Building Construction and Materials".
- C. ASTM E 814, "Fire Tests of Penetration Fire-stop Systems".
- D. ANSI/UL263, "Fire Tests of Building Construction and Materials".
- E. ANSI/UL723, "Surface Burning Characteristics of Building Materials".
- F. ANSI/UL1479, "Fire Tests of Through Penetration Fire-stops".
- G. Underwriters Laboratories Inc. (UL) – Fire Resistance Directory
- H. National Fire Protection Association (NFPA) – NFPA 101: Life Safety Code.
- I. National Fire Protection Association (NFPA) – NFPA 70: National Electrical Code.

1.4 PERFORMANCE REQUIREMENTS

- A. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur, such devices shall:
 - 1. Meet the hourly rating of the floor or wall penetrated.

2. Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
 3. Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:
 - a. Opening or closing of doors.
 - b. Twisting an inner liner.
 - c. Removal or replacement of any material such as, but not limited to, sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
 4. Permit multiple devices to be ganged together to increase overall cable capacity.
 5. Allow for retrofit to install around existing cables.
 6. Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes.
- B. Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.
- C. Where non-mechanical products are utilized, provide products that upon curing do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.
- D. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
- E. Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.
- F. It shall be assumed that all wall penetrations require at minimum a fire-stop system which provides a 1-hour rating. It shall also be assumed that any existing penetration used by a contractor for cabling is "owned" by that contractor. They shall be responsible for providing the appropriate fire-stopping materials to fire-stop the penetration regardless of whether fire-stopping existed at the beginning. Any fire-stopping material removed during cable installation shall be replaced with like material.

1.5 SUBMITTAL

- A. The following submittals are due at the Pre-Construction Phase, in accordance with submittal requirements in Section 27 0500 Special Systems:
1. Product Information
 - a. Provide table of contents with all product names, manufacturer, and specific product number identified to accompany manufacturer cut-sheets.
 - b. Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.
 - c. Provide manufacturer's product information cut sheet or specifications sheet with the specific product number identified or filled out.

2. Product Schedule: For each penetration fire-stopping system. Include location and design designation of qualified testing and inspecting agency.
 3. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration fire-stopping condition, submit illustration, with modifications marked, approved by penetration fire-stopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- B. The following submittals are due Post-Construction, in accordance with the submittal requirements in Section 27 05 00 Special Systems:
1. Record Drawings
 - a. In conjunction with horizontal and backbone cable routing, provide scaled drawings (not less than 1/8" = 1'-0") indicating the location of fire-stop penetrations. Design drawings or shop drawings modified in the field will not be accepted.
 - b. Installer Certificates: From Installer indicating penetration fire-stopping has been installed in compliance with requirements and manufacturer's written recommendations.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration fire-stopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration fire-stopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Penetration fire-stopping shall comply with the following requirements:
1. Penetration fire-stopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 2. Penetration fire-stopping is identical to those tested per testing standard referenced in "Penetration Fire-stopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration fire-stopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration fire-stopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
1. Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.

2. Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.

B. Storage and Protection:

1. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.8 PROJECT CONDITIONS

- A. Do not install fire-stopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- B. Do not install fire-stopping products when substrates are wet due to rain, frost, condensation, or other causes.
- C. Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- D. Do not use materials that contain flammable solvents.
- E. Coordinate construction of openings and penetrating items to ensure that through- penetration fire-stop systems are installed according to specified requirements.
- F. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire-stop systems.
- G. Schedule installation of fire-stopping after completion of penetrating item installation but prior to covering or concealing of openings.

PART 2 – PRODUCTS

2.1 MANUFACTURES

- A. Subject to compliance with requirements, provide products by one of the following:
 1. Specified Technologies, Inc.
- B. Substitutions: No substitutions shall be allowed for Fire Rated Cable Pathways.

2.2 MATERIALS

- A. General: Use only fire-stopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.
- B. Fire-stop Sealants: STI SpecSeal® Brand single component latex formulations that upon cure. Do not re-emulsify during exposure to moisture. Fire-stop Sealants shall be used to fill annular space around between wall substrate and sleeve. The following products are acceptable:

1. Specified Technologies Inc. (STI) SpecSeal® Series SSS Sealant
 2. Specified Technologies Inc. (STI) SpecSeal® Series LCI Sealant
- C. Fire-stop Putty: STI SpecSeal® Brand intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds. Fire-stop Putty shall be used to seal through-penetrations such as traditional conduit sleeves. The following products are acceptable:
1. Specified Technologies Inc. (STI) SpecSeal® Series SSP Putty
- D. Fire-stop Pillows: STI SpecSeal® Brand re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag. Fire-stop Pillows shall be used to seal large through penetrations such as those created to allow cable trays to pass through fire rated walls. The following products are acceptable:
1. Specified Technologies Inc. (STI) SpecSeal® Series SSB Pillows
- E. Fire Rated Cable Pathways: STI EZ-PATH™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill. STI EZ-PATH shall be used for sleeves into Telecommunications Spaces and shall be the base standard for penetrations into classrooms/labs/offices, etc. that require a fire-stopped penetration. At minimum, each telecommunications space shall have two (2) SERIES 44+ sleeves from the telecommunications space to the adjacent accessible corridor. At minimum each stacked telecommunications space shall have one (1) EZ-PATH Pathway Module (EZD444MBS) installed between floors. Coordinate penetration with Architect and Structural Engineer during design. At minimum, one (1) EZ-PATH Series 22 Fire Rated Pathway shall be used to enter classrooms/labs/offices that require a fire-stopped penetration. The following products are acceptable:
1. Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway
- F. Fire-stop Plugs: Re-enterable, foam rubber plug impregnated with intumescent material for use in blank openings and cable sleeves. Fire-stop Plugs shall only be used for existing 2- inch or 4-inch penetrations that require fire-stopping. The following products are acceptable:
1. Specified Technologies, Inc. (STI) SpecSeal Series FP Fire-stop Plug
- G. Fire-Rated Cable Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing individual cable penetrations up to 0.27 in. (7 mm) diameter. Fire-Rated Cable Grommets shall be prohibited without prior approval by the Engineer or Owner. If approved, the following products are acceptable:
1. Specified Technologies, Inc. (STI) Ready Fire-stop Grommet

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of fire-stopping in accordance with manufacturer's installation instructions and technical bulletins.

- B. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
- C. Provide masking and temporary covering to protect adjacent surfaces.
- D. Do not proceed until unsatisfactory conditions have been corrected INSTALLATION
- E. General: Install through-penetration fire-stop systems and fire-resistive joint systems in accordance with the required performance requirements and in accordance with the conditions of testing and classification as specified in the published design.
- F. Comply with manufacturer's instructions for installation of fire-stopping products and the following.
 - 1. Seal all openings or voids made by penetrations to ensure an air and water resistant seal.
 - 2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of through-penetration fire-stop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - 3. Protect materials from damage on surfaces subjected to traffic.
 - 4. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition might occur such as the intersection of a gypsum wallboard/steel stud wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.
 - 5. Where joint application is exposed to the elements, fire-resistive joint sealant must be approved by manufacturer for use in exterior applications and shall comply with ASTM C-920, "Specification for Elastomeric Joint Sealants".
- G. Perimeter Containment: Comply with manufacturer's instructions for installation of perimeter fire containment system products.
 - 1. Seal all slab-edge openings to ensure an air and water resistant seal.
 - 2. Safing insulation shall be installed with the grain oriented vertically to maintain effective compression between edge of floor assembly and curtain wall.

3.2 IDENTIFICATION

- A. Comply with EIA/TIA-606-A
- B. A fire-stop identification label shall be applied to the wall substrate adjacent to the through penetration or joint fire-stop system.
- C. At minimum, the label shall contain the following information:
 - 1. Fire-stop Identification per Section 270553
 - 2. Fire-stop product/system used
 - 3. Installation Company
 - 4. Penetration Hour Rating
 - 5. Installation Date

3.3 FIELD QUALITY CONTROL

- A. Inspections: Owner shall engage a qualified independent inspection agency to inspect through-penetration fire-stop systems.

- B. Keep areas of work accessible until inspection by authorities having jurisdiction.
- C. Where deficiencies are found, repair or fire-stopping products so they comply with requirements.

3.4 ADJUSTING AND CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed openings to be free of excess fire-stopping materials and soiling as work progresses.

END OF SECTION 27 05 45

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SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Ladder Cable Runway: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- C. LAN: Local area network

1.3 SUMMARY

- A. Section Includes:

- 1. Telecommunications mounting elements.
- 2. Backboards.
- 3. Telecommunications equipment racks and cabinets.
- 4. Telecommunications service entrance pathways.
- 5. Grounding.

- B. Related Sections:

- 1. Retain Sections in subparagraphs below that contain requirements Contractor might expect to find in this Section but are specified in other Sections.
- 2. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
- 3. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
- 4. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.4 SUBMITTALS

- A. Product Data: Submit for each type of product provided.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- C. Grounding: Comply with ANSI-J-STD-607-A.

1.6 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Adjust arrangements and locations of cross-connects (distribution frames) in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 - 3. Adjust arrangements and locations of equipment that share space in the equipment room.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 – PRODUCTS

2.1 PATHWAYS

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications". Basket Cable Trays not allowed within Equipment Rooms (ER) and Telecommunication Rooms (TR).

2.2 BACKBOARDS

- A. Backboards: Plywood; non-conductive, fire-retardant treated, and 3/4 by 48 by 96 inches.

2.3 EQUIPMENT FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chatsworth
 - 2. B-Line
 - 3. Hubbell
 - 4. Leviton
 - 5. Hoffman

B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.
4. All horizontal cables shall terminate on 48 port patch panels of the same category as the cable.
5. All rack hardware shall be grounded as described in TIA-942.

C. Floor-Mounted Racks: Modular-type, 2-post, aluminum or steel construction, 7 feet in height and 19 inches wide with 3-inch channels.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug and a power strip.
2. Baked-polyester powder coat finish of color black.
3. Secured to floor with appropriate hardware and overhead ladder cable runway.

D. Wall-Mounted Racks: Owner-furnished Contractor-installed.

Double-hinged, steel construction, 24" H X 24" W X 25" D.

E. Cable Management for Equipment Frames:

1. Metal with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels between and on each side of rack shall have 6-inch-wide and 8-inch-deep front and rear channels with covers.
4. Provide horizontal crossover cable manager above, below, and between each copper patch panel with a minimum height of 2 rack units (2RU) each.

2.4 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Rack mounting.
2. Six, 15 A, 120 Volt ac, NEMA WD 6, Configuration 5-15R; 20 A, 120 Volt ac, NEMA WD 6, Configuration 5-20R receptacles.
3. LED indicator lights for power and protection status.
4. LED indicator lights for reverse polarity and open outlet ground.
5. Rocker-type on-off switch, illuminated when in on position.

2.5 FIRESTOPPING

A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

2.6 GROUNDING

A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

- B. Telecommunications Ground Bars:
 - 1. Connectors: Mechanical type, cast silicon bronze, solderless, compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Telecommunications Main Ground Bus Bar (TMGB): Copper, minimum 1/4-inch-thick by 4 inches wide and a minimum of 12 inches long with 9/32-inch holes spaced 1-1/8 inches apart.
 - 3. Telecommunications Ground Bus Bar (TGB): Copper, minimum 1/4-inch-thick by 2 inches wide and a minimum of 12 inches long with 9/32-inch holes spaced 1-1/8 inches apart.
 - 4. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 volt. Lexan or PVC, impulse tested at 5000 volt.

- C. Comply with ANSI-J-STD-607-A.

2.7 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Cabling, jacks, and patch panels shall be labeled as follows: TR #/Switch #/ Port #

PART 3 – EXECUTION

3.1 GENERAL

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 BACKBOARDS

- A. Provide plywood backboards on all four walls of each telecommunications room.
- B. Install backboards with 96-inch dimension vertical. Bottom of plywood is to be six inches above finished floor. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.
- C. Paint backboards flat white.

3.3 EQUIPMENT FRAMES

- A. All racks shall be placed in manner that allows for a minimum of 3 feet of clearance in front and behind all rack mounted devices.
- B. All racks shall be securely attached to the concrete floor using 3/8-inch hardware.
- C. All racks shall be grounded to the TGB or TMGB.

- D. Cross connecting all Telephone and Data services shall be the responsibility of owner.

3.4 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities". Install underground entrance pathway complying with Division 26, Section 26 05 33, "Raceway and Boxes."

3.5 PATHWAYS

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications". Basket Cable Trays not allowed within Equipment Rooms (ER) and Telecommunication Rooms (TR).
- B. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of the room where multiple sheets of plywood are installed around the perimeter walls.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits entering or leaving building 4 inches above finished floor.
 - 5. Extend sleeves and conduits between floors 1 to 3 inches above finished floor
 - 6. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.6 WIRING

- A. All cables in the Equipment Rooms and Telecommunication Rooms shall have a non-coiled slack loop by taking the longest usable route to terminate a 3-foot coiled service loop.

3.7 FIRESTOPPING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

3.8 GROUNDING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".
- B. Provide Telecommunications Main Ground Bus Bar (TMGB) in the Equipment Room.
- C. Provide Telecommunications Ground Bus Bar (TGB) in each Telecommunications Room.

- D. Locate grounding bus bars to minimize the length of bonding conductors. Fasten to wall allowing at least two-inch clearance behind the grounding bus bar. Connect grounding bus bars with No. 6 AWG stranded copper wire to the nearest electrical panel ground and to the building steel. If located outside the room, use No. 4 AWG stranded copper.
- E. Connect telecommunications main grounding bus bar with a minimum No. 4 AWG stranded copper grounding electrode conductor to building main service ground point. This installation and termination shall be performed by a licensed electrical contractor. Label "TMGB - Do not disconnect."
- F. All racks shall be grounded to the TMGB or TGB in the respective room by the telecommunication installer.

3.9 IDENTIFICATION

- A. Identify system components, wiring and cabling complying with TIA/EIA-606-A and paragraph 2.7. Comply with requirements in Division 26, Section 26 05 53, "Identification."
- B. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration.
- C. Labels shall be preprinted or computer-printed type.

END OF SECTION 27 11 00

SECTION 27 13 00

COMMUNICATIONS BACKBONE WIRING

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 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International, Inc.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference
- D. IDC: Insulation displacement connector
- E. LAN: Local area network
- F. UTP: Unshielded twisted pair

1.3 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between telecommunications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection. Install backbone cables as shown on the drawings.
- B. Bridged taps and splitters shall not be used as part of backbone cabling.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

1.5 SUBMITTALS

- A. Product Data: Submit for each type of product provided.
- B. Shop Drawings:

1. System Labeling Schedules:
 - a. Electronic copy of labeling schedules shall be in software and format selected by Owner.
 - b. Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics including the following:
 - a. Cross-connects
 - b. Patch panels
4. Cross-connects and Patch Panels: Detail mounting assemblies, and show elevations and physical relationship between the installed components.
5. Cable Tray Layout: Show cable tray route to scale with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.6 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with the Owner's telecommunications and LAN equipment and service suppliers.

PART 2 – PRODUCTS

2.1 PATHWAYS

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

2.2 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Berk-Tek
 2. CommScope
 3. Mohawk
 4. Optical Cable Corp.
 5. Superior Essex
 6. Leviton
- B. Description: 100-ohm, 24-AWG minimum, solid conductor, UTP, pair quantity as indicated covered with a gray thermoplastic plenum-rated jacket and overall metallic shield.
 1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.

4. Listed and labeled by an NRTL acceptable to Authorities Having Jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - b. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
5. Cables shall be in standard increments to the size of the project (one pair per installed horizontal cable fed from respective telecommunications room).

2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Berk-Tek
 2. CommScope
 3. Mohawk
 4. Optical Cable Corp.
 5. Superior Essex
 6. Leviton
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category.
- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables. One terminal per field for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. One jack per field for each four-pair UTP cable indicated. Category 6 rated.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

2.4 OUTSIDE PLANT MULTIMODE OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Berk-Tek
 2. CommScope
 3. Mohawk
 4. Optical Cable Corp.
 5. Superior Essex
 6. Leviton
- B. Description: OSP Multimode, 50/125-micrometer, OM3, nonconductive, loose-tube, optical fiber cable, number of strands as indicated on the drawings.

1. Underground routing shall be in conduit.
2. Shall be loose tube; gel filled utilizing non-hygroscopic, non-conductive, flooded core, homogenous gel.
3. Buffer tubes requiring stripes shall have co-extrusion inlaid stripes of contrasting color.
4. Maximum Attenuation: 0.50 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

C. Jacket:

1. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
2. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.5 MULTIMODE OPTICAL FIBER RISER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berk-Tek
2. CommScope
3. Mohawk
4. Optical Cable Corp.
5. Superior Essex
6. Leviton

B. Description: X10G Multimode, 50/125-micrometer, OM3, laser optimized, nonconductive, tight buffer, optical fiber cable, number of strands as indicated on the drawings. Riser cable shall be 900-micrometer and mechanically strippable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
4. Listed and labeled by an NRTL acceptable to Authorities Having Jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - b. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
6. Minimum Modal Bandwidth: 2000 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
7. Hybrid cables can be utilized upon prior approval.

C. Jacket:

1. Jacket Color: Aqua for 50/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.6 SINGLEMODE OPTICAL FIBER RISER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berk-Tek

2. CommScope
3. Mohawk
4. Optical Cable Corp.
5. Superior Essex
6. Leviton

- B. Description: Singlemode, 8.3/125-micrometer, nonconductive, tight buffer, optical fiber cable, number of strands as indicated on the plans. Riser cable shall be 900-micrometer and mechanically strippable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
4. Listed and labeled by an NRTL acceptable to Authorities Having Jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - b. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
5. Maximum Attenuation: 1.0 dB/km at 1310 nm; 1.0 dB/km at 1550 nm.
6. Hybrid cables can be utilized upon prior approval.

- C. Jacket:

1. Jacket Color: Blue for 50/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.7 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berk-Tek
2. CommScope
3. Mohawk
4. Optical Cable Corp.
5. Berk-Tek
6. Leviton

- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors. One connector per field for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

- C. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Type LC connectors. Insertion loss not more than 0.75 dB.
 - a. Aqua connector color for multimode fibers.
 - b. Blue connector color for singlemode fibers.

2.8 INNERDUCT

- A. 1" diameter, orange, plenum-rated, corrugated raceway.

2.9 FIRESTOPPING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

2.10 GROUNDING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

2.11 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26, Section 26 05 53, "Identification."

2.12 SOURCE QUALITY CONTROL

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

PART 3 – EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum-rated cable and innerduct in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 26, Section 26 05 33, "Raceway and Boxes."
 - 3. Conceal conductors and cables in accessible ceilings, walls and floors where possible.
- B. Wiring within Enclosures: Bundle, lace and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 PATHWAYS

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

3.4 CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. MUTOA shall not be used as a cross-connect point.
 - 6. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
 - c. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than six inches from cabinets, boxes, fittings, outlets, racks, frames and terminals.
 - 8. Install lacing bars to restrain cables, to prevent straining connections and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 9. Bundle, lace and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable regardless of whether the cable passes Category 6 testing standards.
 - 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 12. In the Communications Equipment Room and Telecommunication Rooms, install a 10-foot-long service loop on each end of cable when routed within building.
 - 13. In the Communications Equipment Room, install a 50-foot-long service loop on each end of cable when entering or leaving the building.
 - 14. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

3. Cable shall be terminated in 19-inch rack mounted 110-style IDC frame kits, which include frame, blocks, bottom trough, horizontal wire troughs, connecting blocks, and designation strips. Frames and bottom troughs shall be constructed of carbon steel. Wiring blocks, connecting blocks and horizontal troughs shall be constructed of polycarbonate molding compound
 4. Wire management frames shall be mounted between adjacent vertical frames to provide wire management of cross-connect wire.
 5. Wiring blocks shall be marked black every fifth pair.
 6. Connecting block terminals shall be constructed of phosphor bronze, plated with a minimum of 150µin of tin-lead over a 50µin minimum nickel underplate.
 7. Combinations of 100-pair frames shall be used as required by the backbone pair counts to be terminated in a given room. Backbone frames shall employ 5-pair connecting blocks on each 25-pair row.
 8. Punch-down order should follow traditional USOC color code order for multi-pair telephone cables. All termination blocks must utilize a label holder, all labels shall be machine printed on one side and have laminate protective cover and adhere well to cable or label holder
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable shall be terminated on connecting hardware that is in 19-inch rack mounted enclosures with covers that can be closed. Each enclosure will be labeled and each label will be machine printed with permanent ink.
 3. All fiber enclosures will be managed with jumper trays below the enclosure.
 4. Pulling tension for OSP single mode fiber optic cable shall not exceed 400 pounds or maximum rating of cable, whichever is lesser.
 5. If mechanical assistance is required to pull cable through conduit system, then the use of a tension limiting device and a force gauge is required.
 6. Fiber Optic cables are to be run inside innerduct that is attached to cable tray, saddle bags, J-hook system, or inside conduits.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of eight inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Group connecting hardware for cables into separate logical fields.
- G. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2kVA: A minimum of five inches.
 - b. Electrical Equipment Rating between 2 and 5kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5kVA: A minimum of 24 inches.
 - d. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

- e. Electrical Equipment Rating Less Than 2kVA: A minimum of 2-1/2 inches.
 - f. Electrical Equipment Rating between 2 and 5kVA: A minimum of six inches.
 - g. Electrical Equipment Rating More Than 5kVA: A minimum of 12 inches.
 - h. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - i. Electrical Equipment Rating Less Than 2kVA: No requirement.
 - j. Electrical Equipment Rating between 2 and 5kVA: A minimum of three inches.
 - k. Electrical Equipment Rating More Than 5 kVA: A minimum of six inches.
 - l. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
3. Separation between Communications Cables and Fluorescent Fixtures: A minimum of five inches.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

3.6 GROUNDING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

3.7 IDENTIFICATION

- A. Identify system components, wiring and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26, Section 26 05 53, "Identification."
 - 1. Administration Class: 3.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications spaces, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

- F. Cable and Wire Identification:
 - 1. Label each cable within four inches of each termination and tap, where it is accessible in a cabinet or pull point, or junction outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - c. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 - 5. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

- G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A. Cables use flexible vinyl or polyester that flex as cables are bent. Label shall be UV-resistant.

- H. Label shall identify cable origination and termination.

3.8 FIELD QUALITY CONTROL

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

END OF SECTION 27 13 00

SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. Division 28 specifications and Technology Component Systems Matrix at the end of the Electrical specifications.

1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International, Inc.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference
- E. IDC: Insulation displacement connector
- F. LAN: Local area network
- G. MUTOA: Multiuser telecommunications outlet assembly; a grouping in one location of several telecommunications outlet/connectors.
- H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- I. UTP: Unshielded twisted pair

1.3 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the Telecommunications Room and the point of use devices. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 - 1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 - 2. Bridged taps and splices shall not be installed in the horizontal cabling.
 - 3. Splitters shall not be installed as part of the optical fiber cabling.
 - 4. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equip-

ment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

5. Do not pull separate cable for telephone. Telephone connections are included as one of the Category 6A cables at every location.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

1.5 SUBMITTALS

- A. Product Data: Submit for each type of product provided.
- B. Shop Drawings:
 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 3. Cabling administration drawings and printouts.
 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects
 - b. Patch panels
 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 6. Cable tray layout, showing cable tray route to scale with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions
 - b. Clearances for access above and to side of cable trays
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.6 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.
- C. Coordinate with the Integrated Systems contractor per Division 28 specifications.

PART 2 – PRODUCTS

2.1 PATHWAYS

- A. Comply with requirements in Division 27, Section 27 05 00, “Common Work Results for Commu- nications”.

2.2 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berk-Tek
 - 2. CommScope
 - 3. Mohawk
 - 4. Optical Cable Corp.
 - 5. Superior Essex
 - 6. Leviton
- B. Description: 100-ohm, solid conductor, four-pair UTP, plenum-rated. Category 6A for general outlets, WAP’s and Integrated Systems. Cat 6A cables shall be covered with a blue thermo- plastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-568-B.2, Category 6 or 6A.
- C. Install cables from the nearest Telecommunications Room to each of the following:
 - 1. Two cables to standard data outlets, unless noted otherwise.
 - 2. One cable to Wireless Access Points.
 - 3. One cable to IP Intercom Speaker/Clock in classrooms and private rooms.
 - 4. One cable to Intercom Zone Modules for analog speakers in common spaces.
 - 5. One cable to video surveillance cameras.
 - 6. One cable to Access Control, Intrusion Detection, and Security Panels.
 - 7. Other devices listed in the Technology Component System Matrix.
- D. Provide OSP-rated cables for outdoor or underground installations.

2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Berk-Tek
 - 2. Commscope
 - 3. Mohawk
 - 4. Optical Cable Corp.
 - 5. Superior Essex
 - 6. Leviton

- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category.
- C. Connecting Blocks: 110-style IDC for Category 6a to match cable. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables. One terminal per field for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. One jack per field for each four-pair UTP cable indicated. Cat 6a rated to match cable.
- F. Jacks and Jack Assemblies: Modular, Cat 6a to match cable, eight-position modular receptacle units with integral IDC-type terminals.

2.4 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1, Cat 6a to match cable.
- B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.
 - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26, Section 26 27 26, "Wiring Devices."
 - 2. Snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks.
 - b. Legend: Machine printed in the field using adhesive-tape label. Sequential labeling from left to right, top to bottom.
 - c. Sequential labeling of jacks from left to right, top to bottom. Each jack shall be numbered with the same number as attached cable.
 - d. Blank inserts/modules shall match faceplate in color.
 - e. Category jacks shall match faceplate color. Modules shall accept icon designators.
 - 1) Black icon indicating a data/PC connection
 - 2) Blue icon indicating a voice/telephone connection
 - 3) Yellow icon indicating a voice/telephone connection
 - f. BNC coaxial bulkheads shall match faceplate in color.
 - g. Shall snap into all outlets and modular patch panels.
 - 3. Legend: Snap-in, clear-label covers and machine-printed paper inserts.
- C. Outlet Boxes:
 - 1. Comply with requirements in Division 26, Section 26 05 33, "Raceway and Boxes." Shall be no smaller than 4-11/16 inches wide, 4-11/16 inches high, and 3 inches deep.
- D. Floor boxes and Poke-Thru Devices:
 - 1. For connection to modular furniture, provide 2-inch pathway for cables.

2. For plug in at floor locations, provide faceplate and jacks and ensure permits installation of Category cables.
 3. Poke-thru must have the same or higher fire-rating as the floor it penetrates.
 4. Provide metal separation between electrical and telecommunication cables.
 5. Provide all covers, top plates, carpet rings, angle connectors, conduit, jacks, and hinged covers for floor boxes and poke-thrus.
- E. Wall Phone Faceplates: mounted per ADA forward reach specifications. Wall phone locations will have only 1 Category 6 cable pulled to each location.

2.5 FIRESTOPPING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

2.6 GROUNDING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26, Section 26 05 53, "Identification."
- C. Each and every cable will be uniquely identified and will have the same identification at the jack and telecommunications room or equipment room. Provide labels at approximately 6 inches from termination on each end.
- D. All labels will be computer generated, wrap-around, self-laminating, and will be permanent. No permanent markers are to be used for final labeling.
- E. Owner will provide labeling and numbering format along with port numbers for both work area outlets and telecommunication rooms and equipment rooms.

2.8 SOURCE QUALITY CONTROL

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

PART 3 – EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways within consoles, cabinets, desks, counters, and exposed locations. Cables may be run free-air above accessible ceilings. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
 2. Comply with requirements for raceways and boxes specified in Division 26, Section 26 05 33, "Raceway and Boxes."
 3. Conceal conductors and cables in accessible ceilings, walls and floors where possible.
- B. Wiring within Enclosures: Bundle, lace and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- C. All horizontal cables shall be wired according to T568B pin/pair assignments.

3.2 PATHWAYS

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

3.3 CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
1. Comply with TIA/EIA-568-B.1.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 5. MUTOA shall not be used as a cross-connect point.
 6. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
 - c. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than six inches from cabinets, boxes, fittings, outlets, racks, frames and terminals.
 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 9. Bundle, lace and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 10. Pulling tension above maximum allowable tension for cable being used will result in the cable being deemed damaged.
 11. Do not install bruised, kinked, scored, deformed or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable regardless of whether the cable passes Category 6 or 6A testing standards.
 12. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

13. Install a 10-foot-long service loop on each end of cable in the communications equipment room.
14. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of eight inches above ceilings by J-hook cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2kVA: A minimum of five inches.
 - b. Electrical Equipment Rating Between 2 and 5kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5kVA: A minimum of 24 inches.
 - d. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - e. Electrical Equipment Rating Less Than 2kVA: A minimum of 2-1/2 inches.
 - f. Electrical Equipment Rating Between 2 and 5kVA: A minimum of six inches.
 - g. Electrical Equipment Rating More Than 5kVA: A minimum of 12 inches.
 - h. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - i. Electrical Equipment Rating Less Than 2kVA: No requirement.
 - j. Electrical Equipment Rating Between 2 and 5kVA: A minimum of three inches.
 - k. Electrical Equipment Rating More Than 5kVA: A minimum of six inches.
3. Separation between Communications Cables and Electrical Motors and Transformers, 5kVA or HP and Larger: A minimum of 48 inches.
4. Separation between Communications Cables and Fluorescent Fixtures: A minimum of five inches.

3.4 FIRESTOPPING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

3.5 GROUNDING

- A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26, Section 26 05 53, "Identification."
 - 1. Administration Class: 3.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing and management. Use unique alphanumeric designation for each cable and label cable, jacks, connectors and terminals to which it connects with same designation. Cable and asset management software shall reflect final as-built conditions.
- C. Comply with requirements in Division 09, Section 09 91 23, "Interior Painting" for painting backboards. Do not paint over manufacturer's label for fire-resistant plywood.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets; backbone pathways and cables; entrance pathways and cables; terminal hardware and positions, horizontal cables, work areas and workstation terminal positions; grounding buses and pathways; and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings in software and format selected by Owner.
- G. Cable and Wire Identification:
 - 1. Label each cable within four inches of each termination and tap where it is accessible in a cabinet, junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device shown.
 - b. Label each unit and field within distribution racks and frames.
 - c. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Use a different color for jacks and plugs of each service where similar jacks and plugs are used for both voice and data communication cabling.

5. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color, but still complies with requirements in TIA/EIA-606-A. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Comply with requirements in Division 27, Section 27 05 00, "Common Work Results for Communications".

END OF SECTION 27 15 00

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SECTION 27 21 72

CLASSROOM AUDIO / VIDEO DISTRIBUTION SYSTEM

PART 1 – GENERAL

1.1 GENERAL

- A. Provide coordination and details to support conduit and raceway installation specified under Section 27 0500.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections apply to work of this section.
- B. Division 26 and associated electrical, power and grounding requirements.

1.3 SUMMARY

- A. The systems shall be called the “Classroom Audio / Video System” and the installer, the “A/V System Installer”. System equipment and installation including but not limited to:
 - 1. Loudspeakers. Enclosures and speaker mounting or support hardware including speaker mounting frames and incidental steel support members.
 - 2. Audio Amplifiers (CFCI)
 - 3. Apple TV device (OFOI)
 - 4. Flat Screen Displays (OFCI)
 - 5. Cables, connectors, interface plates and wiring.
- B. Products Installed But Not Furnished Under This Contract:
 - 1. Flat Screen Displays, other program sources
- C. Products Provided and Installed by the Owner
 - 1. Computers
 - 2. Document Cameras
 - 3. Apple TV devices

1.4 REFERENCES:

- A. *Sound System Engineering* (2nd Edition), Davis and Davis, Howard W. Sams 1987.
- B. *Audio System - Design and Installation*, Giddings, Howard W. Sams, 1990.
- C. ANSI S4.46-1992.

- D. EIA Standard AS-160.
- E. EIA Standard RS-219.
- F. EIA Standard RS-460.

1.5 QUALIFICATIONS

- A. All Audio / Video system equipment shall be supplied and installed by an authorized factory distributor.
- B. The system shall be guaranteed for a period of one year from the date of acceptance or first beneficial use, whichever is first, against defects in materials, workmanship, design and improper adjustment. Any defects in the system shall be corrected at no expense to the Owner, provided the system does not show signs of abuse. During the guarantee period, any work found not to be in conformance with the plans, specifications and addenda shall be brought into conformity with same at no additional cost to the Owner.
- C. Approval request for installation of equipment not as specified herein must be received by the architect not less than ten days prior to bid opening. Proposals must be accompanied by complete technical data including: Equipment list on contractor's letterhead listing major system components, such as loudspeakers, amplifying and control equipment including mixers, equalizers, signal processors, matching transformers, equipment housings, ancillary equipment, microphones, cabling etc. Compilation of manufacturers catalogs or specification sheets of major components and block diagrams. It is the sole responsibility of the contractor to prove equality to the satisfaction of the engineer including, laboratory test data, fabrication techniques, installation and testing procedures. Potential bidders submitting proposals for prior approval must provide, upon request, a working demonstration system for the Owner's inspection prior to final acceptance to insure that the submitted components are equal to the specified in all functional aspects.

1.6 SUBMITTALS

- A. Computer Design: Provide computer aided design drawings and documentation clearly indicating proposed design. At a minimum the documentation shall show mounting and coverage of the speakers, wallplate design showing labeling and graphical depiction of each component / jack in addition to a functional system one-line drawing. All computer line drawings shall be printed using a pen / inkjet plotter or laser printer for clarity.
- B. Provide clearly identified, complete catalog cuts of all major components including but not limited to:
 - 1. Head end equipment, including mixers, amplifiers, switchers, signal processors, etc.
 - 2. Loudspeakers including; baffles, special mounting enclosures, crossovers, matching networks and protection circuits.
 - 3. Equipment cabinets and enclosures
 - 4. Trim and interface plate fabrication details.
 - 5. Backboxes and specialty rough-ins
 - 6. Wire and cable

- C. Provide shop drawings showing engineering details of equipment interconnection including point to point wiring, switching configurations, matching networks and pads, rack elevations and equipment layout, speakers with proposed mounting and aiming. Proposed wire routing, rough-in and installation information.

1.7 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide 3 complete bound O&M manuals describing maintenance and operation of the system. Include descriptions and service data on all component parts. Manual shall also include the following.
 - 1. Warranty statement indicating effective dates.
 - 2. Complete engineering data on all systems furnished including point to point wiring diagrams of the system in its "as built condition.
 - 3. Step by step instructions on operational procedures, including power up and power down sequences, special operational guidelines and standard preventative maintenance procedures.

1.8 SYSTEM DESCRIPTION

- A. Provide a complete and functioning Audio / Video distribution system for each Classroom and other rooms per these specifications and as shown on the drawings. The Audio system will be complete and fully functional, clearly audible and absent of any unwanted clicks, hisses or noise. The Video system shall provide industry standard signal strength from the input location to the projector over system cabling. The system shall be modular in design and shall provide simplified distribution of all audio and video signals through the use of pre-terminated cables.

PART 2 – PRODUCTS

2.1 CLASSROOM AMPLIFICATION:

- A. The Classroom Amplification System shall be mounted as shown on the contract drawings. The three-channel audio mixer / amplifier shall be dedicated for the control of all audio program sources including but not limited to audio from the following:
 - 1. Computer
 - 2. Apple TV device
 - 3. Auxiliary input source
 - 4. Infrared Microphone
 - 5. The output of the Amplification System shall be connected to flush / lay-in ceiling mounted speakers as shown on the contract drawings.
 - 6. The Classroom Audio Mixer Amplifier shall also provide automatic muting when an intercom system page is broadcast.
- B. Classroom Audio / Video Outlet Plates
 - 1. The Classroom Audio / Video outlet plates shall be mounted with the Audio / Video equipment as shown on the contract drawings.
- C. Classroom Speakers

1. The Classroom Speakers shall be a complete loudspeaker assembly, including backbox, and be designed for classrooms with drop-ceilings.
 2. The Classroom speaker shall be flush mounted – full range speaker system to provide clear and natural sound.
 3. Speakers shall be mounted in the ceiling tile grid and be provided with all mounting and support hardware to avoid any sagging of the ceiling tile.
 4. The Speakers shall be installed to provide equal and even distribution of sound as shown on the contract drawings.
 5. Model shall be Quam #8C10PAX.
- D. Audio Mixer Amplifier
1. The unit shall be rated 20W for standard rooms with 2-4 speakers.
 2. The unit shall have wireless capability for interfacing with microphones.
 3. Model shall be Lightspeed 955.
- E. Flat Screen Display Mounting
1. The Classroom A/V Contractor shall provide all required interface cables to the display.
- F. Cable
1. All cable shall be pre-terminated and jacketed cable. It shall be the responsibility of the Audio / Video Contractor to determine the proper type cable to be used. All cable installation shall meet the applicable Building and Electrical code standards.
- G. HDMI Converter. Provide an HDMI De-embedder, Kanex Pro # HAECOAX, at each TV Location.

PART 3 – EXECUTION

3.1 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment shall be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least three (five to one for loudspeaker mountings).
- C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommet.
- D. Speakers mounting in acoustical tile ceilings to be properly supported with tile bridges or other similar structural bracing.
- E. AC Power and Grounding (Provided and installed by others)
- F. Equipment Racks.
 1. Mount equipment in racks and cabinets and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Owner in writing that racks will be fabricated on site and the reasons for the change.

2. Provide ventilation adequate to keep temperature within the rack below 100 degrees Fahrenheit. Provide whisper type ventilation fan in each rack if temperature in rack rises above 100 degrees with power on for five continuous hours.
3. Looking at the rack from the rear, locate AC power, digital control, DC control, and speaker wiring on the left; microphone, line level audio, and video wiring on the right. Panels or equipment mounted on the rear rack rails shall not block access to any front mounted components.

G. System Wiring

1. Take precautions to prevent and guard against electromagnetic and electrostatic hum. For line level audio signals, float cable shields at the output of source device. Shields not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shields.
2. Exercise care in wiring: damaged cables or equipment will not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section. Lace wiring and separate into groups for microphone and line level circuits, loudspeaker circuits, and power circuits.
3. Make connections with rosin-core solder or with mechanical connectors approved by the Owner. Where spade lugs are used, crimp properly with ratchet type tool. Spade lugs mounted on 22 gauge or smaller cable to be soldered after crimping.
4. Route unbroken microphone, audio line, and control wiring from receptacle plate/chassis to Mixer / Amplifier. Remove spliced cables and replace without additional charge to the Owner. Connect cable to active components through screw terminal connections and spade lugs whenever available.
5. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.
6. Execute wiring in strict adherence to "standard broadcast practices," as excerpted from "Recommended Wiring Practices," Broadcast Audio Equipment for AM, FM, Television (5th Edition), Radio Corporation of America (RCA), Camden, N.J. 1962, and Appendix II, "Recommended Wiring Practices", Sound System Engineering, (2nd Edition), D. Davis, and performed in accordance with standard professional practice.
7. Run vertical wiring inside rack in properly sized plastic raceway with snap-on covers (Panduit Type E series). Mount raceways on full length 3/4-inch plywood backboards attached to rack sides. Horizontal wiring in rack to be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Neatly bundle excess AC power cable from rack mounted equipment with plastic cable ties. Rack wiring to be bundled with plastic cable ties or lacing twine. Electrical tape and adhesive backed cable tie anchors are not acceptable.
8. Connect loudspeakers electrically in phase, using the same wire color code for speaker wiring throughout the project.
9. Wiring and connections shall be completely visible and labeled in rack. Termination resistors shall be 1/2 watt 5 per cent tolerance; fully visible and not concealed within equipment or connectors.

H. Equipment and Cable Labeling.

1. Provide engraved lamoid labels on the front and rear of active equipment mounted in racks. Mount labels in a neat, plumb and permanent manner. Embossed labels or P-Touch type labels are not acceptable. Equipment labels to have at least three lines of engraving with the first line listing the general name of the device, i.e., POWER

AMPLIFIER or EQUALIZER. The second line to include the schematic reference of the device, i.e., PA-1A or MIXER-3. The bottom line to indicate what other devices or areas this equipment controls, i.e., FEEDS HF-3&4 or FEEDS XOVER-3.

2. Provide an engraved label over each user-operated control that describes the function or purpose of the control. Label size to be adjusted to fit available space. Engraved labels to have 1/8-inch-high characters typical. Labels to be black with white characters except where indicated. Embossed or P-Touch type labels are not acceptable
3. Cables and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written labels not acceptable.
4. Wiring designations to be an alpha-numeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 3 inches of the point of termination or connection. For cable runs that have intermediate splice points at riser junction boxes, the cable shall have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments to be determined by Contractor.
5. Add cable designation codes to system schematic drawings included with Project Record Drawings.
6. Label each terminal strip with a unique identification code in addition to a numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Drawings.
7. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

3.2 CONTRACTOR'S TESTS, SETUPS AND ADJUSTMENTS

A. Verify the following before beginning actual tests and adjustments on the system:

1. Electronic devices are properly grounded.
2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly.
3. Insulation and shrink tubing are present where required.
4. Dust, debris, solder splatter, etc. is removed.
5. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.

B. Grounding System Tests:

1. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be at least 0.15 ohms or less.
2. Temporarily lift the technical ground from the main electrical ground, measure and record the DC resistance between them. Resistance should be at least 1000 ohms.

3.3 CONTRACTOR TESTING

A. Prior to energizing or testing the system, ensure the following:

1. All products is installed in a proper and safe manner par the manufacturer's instructions.
2. Insulation and shrink tubing are present where required.
3. Dust, debris, solder splatter, etc. is removed.
4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
5. All labeling has been provided.

6. Temporary facilities and utilities have been properly disconnected, removed and disposed off-site.
 7. All products are neat, clean and unmarred and parts securely attached.
 8. All broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.
 9. Electronic devices are properly grounded.
- B. Prior to energizing the system, perform the following tests in compliance with applicable EIA standards. Provide a draft copy of a proposed test report form for review as part of the submittal process. Record the results of each test in the Project Record Manual and have a copy available for the Owner during inspection.
1. Test each AC power receptacle with a circuit checker to; proper hot, neutral and ground connections.
 2. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.
 3. Temporarily lift the technical ground from the main electrical ground, measure and record the DC resistance between them. Resistance should be 1000 ohms or greater.
 4. Measure the impedance of each speaker line leaving the equipment racks. For full range devices, use a frequency of 1000 Hz, for band limited devices; use a frequency appropriate for the operating range of the transducer. When documenting the results of these tests, include the calculated impedances based on number of units on a line and the size and distance of the run. Correct any field readings that differ more than 20 per cent from the calculated impedances.
- C. Speaker Circuit Verification Test
1. Provide a low level, distinctive test tone to each amplifier input.
 2. Turn on one channel of Amplifier #1 and verify that the correct speaker or group of speakers is operating. Correct any wiring or other problems found.
 3. In a similar manner, check each channel of all remaining amplifiers and their respective speaker circuits.
 4. Include the results of the tests in the Project Record Manual.
- D. Volt Speaker Test
1. Play music, pink noise or other distinctive audio signal through each group of 70 volt speakers. Only one amplifier channel should be on at a time. Confirm stereo operation as needed.
 2. Walk the area covered by the speakers.
 3. Verify that each speaker is operating and that there are no significant changes in volume level from one speaker to the next.
 4. Verify that the extent of coverage is consistent with the areas indicated on the drawings.
- E. Speaker Polarity Verification Test
1. Use an electronic polarity checker, TEF machine, JBL SMAART PRO, SIM II, or other similar device to test each reinforcement speaker. All speakers should have the same relative polarity.
 2. Follow manufacturer's recommendations in conducting the tests.
 3. In a similar manner, check all distributed speakers to ensure they have the same polarity.
 4. Include the results of the tests in the Project Record Manual.
- F. System Gain Adjustment

1. Adjust each active device to have unity gain from the console output to the input of the crossover.
2. With all amplifiers turned off, connect a sine wave or pink noise generator to the input of the console. Using a RMS AC voltmeter with a dB scale, adjust the console to an output between -10 and 0dBu. Once the level has been established, it should remain unchanged throughout the test. All equalizers should be set flat for this test.
3. Follow the signal flow from the console to each subsequent component. Measure the input level and output level of each device at the point of connection to the device. The input level reading should differ no more than 0.25 dB from the level recorded for the preceding device. Diagnose and correct the wiring or equipment when any readings that exceed this range.
4. Adjust the output of each component to match the reference level coming from the console. Output level should differ no more than 0.5 db from the console output level.
5. Record the output levels of each device on the Project Record Drawings.

G. Amplifier Level Adjustment - Main Reinforcement System

1. Adjust the gain of each amplifier to provide a consistent and appropriate volume level throughout the facility.
2. Begin by connecting a pink noise source to one input of the mixing console. Adjust the console output to -10 dB on the VU meter.
3. Using main reinforcement speakers, adjust the appropriate amplifiers to achieve 85 dBA in the area covered by the speakers. Use a calibrated sound level meter to make the measurement. Amplifiers should be set to provide an average of 85 dBA + 1.5 dB throughout each seating section. Coverage at 4 kHz should be no more than +/- 3 dB.
4. Record the setting of each amplifier in the Project Record Manual and keep backup copies of the data file on disk.
5. After setting the amplifier level for each system, play a pink noise signal over the speakers and walk through each area. Using a sound level meter, identify any areas where the SPL changes by more than 3 dB.

3.4 TEST EQUIPMENT

- A. Provide the following equipment on site for final acceptance testing. Test equipment to be available for the entire period through final system acceptance unless noted. Prior to start of testing, provide a list to the Owner of test equipment make and model numbers that will be used.

1. Dual-trace oscilloscope - 100 MHz bandwidth, 1 mV/cm sensitivity.
2. Sound Level Meter: ANSI S1.4-1971 Type SIA with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
3. Pink Noise Source - Equal energy per octave bandwidth 20 Hz to 20,000 Hz, ~1 dB (long-term average) at 0 dBm output.
4. Impedance Meter _ Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 4k Hz. Measurement Range: 1 ohm to 100 k ohms.
5. Multimeter - Measurement range, DC to 20k Hz, 100 mV to 300 V. 10 mA to 10 A.
6. Audio Oscillator: bandwidth 20 Hz to 20k Hz + 1 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level.
7. Ladders and scaffolding necessary to inspect ceiling mounted equipment, speakers or clusters.

- B. The following procedures will be performed by the Consultant on each System:

1. Audio fidelity test: drive the system with pink noise and measure the frequency response in each 1/3 octave band from 40 Hz to 16k Hz. Use 1/6 Octave, 1/3 octave, or parametric filters to adjust the response of the system(s) to fit the requirements of the space.
 2. Control functions shall be checked for proper operation, from controlling devices to controlled devices.
 3. Video systems shall be checked for proper operation and visual quality. All video displays shall be free of hum, distortion and detrimental artifacts.
 4. Adjust, balance, and align equipment for optimum quality and to meet the manufacturers published specifications. Establish and mark normal settings for each level control, and record these settings, in the "System Operation and Maintenance Manual".
 5. Installed and loose equipment will be inventoried for correct quantity.
 6. Any other test on any piece of equipment or system deemed appropriate.
- C. In the event the need for further adjustment or work becomes evident during equalization or acceptance testing, the Contractor will continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications, **the Contractor will pay for additional time** and expenses of the Architect at the Architect's standard rate in effect at that time, during any extension of the acceptance testing period.

3.5 INSTRUCTION OF OWNER PERSONNEL

- A. Provide four hours instruction to Owner designated personnel on the use and operation of the System, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on site at the time of this instruction.

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SECTION 27 51 23

INTERCOM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-26-27 Section.
- B. Drawings and General Provisions of contract, including General and Supplementary Conditions, Division-1 Specification sections and all Division-26-28 sections apply to work of this section.

1.2 GENERAL DESCRIPTION

- A. The general intent of this specification is to provide Intercom devices for district intercommunications system for dial-up two-way loud speaking intercommunication, emergency call-in, audio programming, and class change signaling. The system shall be of modular design to facilitate both expansion and service, and shall be IP -based.
- B. All major communication system equipment shall be supplied and installed by an authorized factory distributor.
- C. The intercom system shall be designed for school applications and shall be completely factory-assembled, wired, and tested by a manufacturer of established reputation.
- D. The communication system contractor shall furnish and install all materials, even though not specifically mentioned herein, which are necessary for the proper integration of the system so that the system shall perform the functions listed herein in compliance with all the specified requirements.
- E. To qualify as a bidder, the installation shall be made by a licensed and bonded contractor holding a valid Washington State Electrical Contractor's License and Administrator's Certificate as described in the Electricians and Electrical Installations Revised Code of Washington State. All work covered by this specification is to be performed by a holder of a current State of Washington Specialty Electrician for limited energy systems.
- F. All major components shall be listed with the Underwriter's Laboratories Re-examination Service. No Exception.
- G. The communication system contractor shall guarantee availability of local service by factory-trained personnel of the equipment manufacturer. The distributor shall have available stock of the manufacturer's standard parts.
- H. The Installing Contractor shall maintain a fully staffed and equipped service facility located within 100 miles of the project site, and shall be a franchised dealer and authorized service facility for the major brands specified.

- I. The contractor shall, at the owner's request, make available a service contract offering continuing factory authorized service of this system after the initial warranty period.
- J. This specification is based upon equipment as manufactured by Rauland. Valcom is also an acceptable manufacturer.
- K. Approval request to pre-qualify for bidding of equipment not as specified herein must be received by the architect not less than one week prior to bid opening. Proposals shall include but shall not be limited to the following: complete technical data and such samples as required indicating that the submitted components are equivalent to the specified equipment in all material aspects; the equipment proposed shall provide a precise functional equivalent to the system specified. The contractor will itemize on a separate enclosure a list of similar previous completed projects with the names and telephone numbers of the owners; number of years in the school communications business; service staff and qualifications; documentation supporting that the contractor represents the products proposed; and the contractors' license number.

1.3 SCOPE OF WORK

- A. The system shall be connected to the School District's telephone communications system Via SIP integration. The intercom system will provide all call (paging), dial-up 2-way loud speaking intercom with hands-free answer back, audio program distribution, time tone signaling, and emergency call-in control. The system will also interface to the Integrated Security system to provide emergency lock down tones and process that are listed in the Security system matrix. All specialty district lock down tones shall be programmed to match the rest of the districts standard practice for school lock down and codes.
- B. The system shall, at a minimum, consist of the following: an owner-provided telephone communications system, owner-provided staff or classroom telephones, a contractor-provided intercom console, loudspeakers, and all of the associated materials, hardware, and wiring necessary for a comprehensive and completely installed system which shall meet all requirements as specified and as shown on the electrical drawings.

1.4 QUALIFICATIONS OF SYSTEM VENDER

- A. The System Vender shall be a factory-authorized dealer/distributor of the intercommunications system equipment manufacturer.

1.5 QUALIFICATIONS OF SYSTEM INSTALLER

- A. The System Installer shall be a factory-authorized dealer/distributor of the intercommunications system equipment manufacturer.

1.6 SUBMITTALS

- A. Qualifications Information: For the System Installer.
- B. Product Data: For each type of intercommunications equipment, loudspeaker, device and cable provided on the Project.

- C. Shop Drawings: Tap settings, floor plans, block diagrams, wiring diagrams and equipment rack layout.
- D. Meeting Minutes: For pre-installation meeting.
- E. Installation and Start-up Instructions: Manufacturer's installation and start-up instructions. Submit a copy to the Architect. F. Test Reports: Record of all field test data.
- F. Training Documentation: Sign-off form and attendee sign-in sheet for the training session.

1.7 INFORMATION FOR OPERATING & MAINTENANCE MANUALS

- A. Submittals: Information submitted for review, up-dated to record any changes.
- B. Operating Instructions: Supply a detailed narrative description of the system operation. Indicate expansion capability, application conditions and limitations of use. Include manufacturer's installation and operating instructions.
- C. Maintenance Instructions: List replacement parts, including source. Indicate recommended maintenance and testing procedures, and the intervals involved for each. List all individual system components that require periodic maintenance. Detail troubleshooting procedures. Include a service directory with names and telephone numbers for use in obtaining service.
- D. Warranty: Manufacturer's warranty certificate.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System: Rauland Telecenter Campus or Valcom IP6000 Series.
- B. Pushbutton Call Stations: Call origination stations shall be pushbutton type, mounted on a single-gang plate in a standard 1-gang outlet box. Each station shall include two (2) momentary-contact pushbuttons, clearly marked "normal" and "emergency", with local call cancellation provisions. Call stations shall be equivalent to Rauland-Borg #TCDPB2.
- C. Bell Schedules:
 - 1. Have the ability to be remotely created, changed, stored and downloaded to the system by an authorized user from a browser-based interface. It shall be possible to perform this function locally at the site via the browser based interface.
 - 2. Unlimited events shall be programmable to any or all of (16) zone circuits.
 - 3. Unlimited number of bell schedules with up to 5 schedules being run concurrently
 - 4. A fully automatic calendar with easy menu-driven executions.
 - 5. User programmable automatic Daylight Savings Time change.
 - 6. Equivalent to Rauland Borg Telecenter Campus controller .
- D. Wall Loudspeakers: Standard 203 mm (8 in) dual-cone type, with 8-ohm nominal input impedance and matching transformer for 25-volt input, suitable for mounting in clock/speaker enclosure or separate wall-mount backbox. Power rating shall be 8 watts RMS, minimum.

Frequency range shall be 100-10,000 Hertz, minimum. Dispersion angle shall be approximately 105°. Ceiling loudspeakers shall be equivalent to Rauland-Borg #USO188.

- E. Ceiling Loudspeakers: Fire-rated 203 mm (8 in) dual-cone type, with 8-ohm nominal input impedance and matching transformer for 25-volt input, suitable for fire-resistant speaker assemblies. Power rating shall be 8 watts RMS, minimum. Frequency range shall be 100-10,000 Hertz, minimum. Dispersion angle shall be approximately 105°. Ceiling loudspeakers shall be equivalent to Atlas Sound #C5AT25FR, except where there is no ceiling and in corridors where the ceiling is not fire-rated ceiling loudspeakers shall be equivalent to Atlas Sound # C5AT25.
- F. Loudspeaker Transformers: 8-ohm type matched to loudspeaker, suitable for connection to 25-volt lines. Minimum RMS power handling rating shall be 5 watts with multiple taps for ceiling paging and intercommunications loudspeakers. Frequency response shall be better than ± 1.5 dB in the range of 100-10,000 Hertz.
- G. Wall Backboxes and Grilles: For wall-mounted loudspeakers and exterior paging horns, provide recessed steel backboxes with acoustically treated interior, sized to accommodate the devices. Grilles for exterior paging horns shall be high-strength aluminum alloy vandal-proof grilles backed by a heavy gauge perforated steel screen. Backboxes for exterior paging horns shall be equivalent to Rauland-Borg #ACC1117 with Rauland-Borg #ACC1014 grilles. Backboxes for combination clock and loudspeakers shall be equivalent to Rauland-Borg #ACC1121. Grilles on exterior speakers shall be painted to match the adjacent surface.
- H. Ceiling Backboxes and Grilles: For ceiling loudspeakers, provide recessed steel backboxes with acoustic padding sized to accommodate the loudspeakers. Grilles shall be 11-gauge steel perforated round grilles, suitable for fire-resistant speaker assemblies. For all loudspeakers recessed in fire-rated ceilings, provide a fire-resistant mineral fiber firebox enclosure consisting of pre-cut fiber panels specifically designed for enclosing the speaker backbox. The entire speaker assembly, including the speaker/transformer, the grille, the backbox and the firebox shall be UL-listed for 3-hour fire resistance per UL Standard 263. Backboxes with firebox enclosures shall be equivalent to Atlas Sound #EZ96-8FR with mounting support rails. Where speakers are mounted in rooms where there is no ceiling and in corridors where the ceiling is not fire-rated, backboxes shall be equivalent to Atlas Sound #96-8. Grilles shall be equivalent to Atlas Sound #62-8FR, except where there is no ceiling and in corridors where the ceiling is not fire-rated grilles shall be equivalent to Atlas Sound #62-8.
- I. Clock/Speaker Backboxes and Front Baffles:
 - 1. For wall-mounted loudspeakers mounted in combination with digital clocks, provide steel backboxes for recessed mounting, each sized to accommodate a 200 mm (8 in) loudspeaker and a 2.5 in digit digital clock.
 - 2. Each backbox shall include a center barrier to divide the speaker compartment from the clock compartment.
 - 3. The interior surfaces shall be acoustically treated to prevent metallic resonance.
 - 4. For each such backbox, provide a matching flush front panel, fabricated of 18- gauge cold-rolled steel with a perforated round grille for the speaker and an opening for mounting the analog clock. Backboxes shall be equivalent to Rauland-Borg #ACC1121.
 - 5. Front panels shall be equivalent to Rauland-Borg #ACC1SAC12. Front panel shall have a power-coated finish to match the color of the adjacent wall surface.
 - 6. Color shall be as selected by the Architect.
- J. Multi Device Patch Panel:

1. Patch panels for quick RJ45 connection of various head end, distributed and classroom devices..
 2. Twelve (12) front panel RJ-45 ports with green audio activity indicators. Provide sufficient patch panels for quantity of stations indicated on the Drawings.
 3. Model Rauland 601101.
- K. Category Cabling Breakout Module:
1. The breakout module shall be used for connection of UTP to classroom devices. With three (3) RJ45, one (1) RJ-11 and eight (8) color-coded pigtailed.
 2. The breakout module shall enable quick connections to classroom devices including, call switches, speakers, and analog clocks.
 3. Model Rauland 603101 Provide 1 per intercom location.
- L. Field wire patch panel:
1. All UTP field cables shall be terminated on a TIA 568 standard 48-port patch panel. Supply sufficient ports that support the individual intercom field devices.
 2. Leviton 5G596-u48 provide as required to support each speaker location.
- M. Rauland TC Campus System or equivalent
1. Classroom IP module: The classroom module shall consist supporting a two way audio signal equipped with a SPST relay for connection to a call switch or other relay triggered devices. The unit is supported with two RJ 45 jacks for network connection and support associated wiring and mechanical components. All connection points shall be clearly labeled and accessible from the rear of the assembly. The relays shall be usable for "intercom", "time tone", "zone page", or "all call" singly or in any combination. Power requirements are POE 802.3af (12 watts per device. Provide as required to cover each staff and classroom station with 10% spares. Model TCC2011.
 2. Zone IP Page module: The zone module with an analog audio output can drive an amplifier to extend paging coverage throughout a facility as well as outdoor playgrounds and other larger areas that are covered by analog speakers. The unit includes 2 relay outputs that close during and active audio event. Power requirements are POE 802.3af (12 watts per device. Provide as required to cover each zone as shown on the contract drawing or listed herein. Model TCC2022.
 3. Auxiliary IP input output module: The Aux module provides 2 network enabled individually addressable contract closures for external devices connected to the Telecenter U. The contacts can be used to control external devices such as fire alarm and security devices. The 2 inputs allow activation of emergencies and sequences via external system or panic button. Power requirements are POE 802.3af (12 watts per device. Provide as required to work with all systems integrated to the intercom system. Model TCC2033.
 4. Zone Page and Audio Program Power Amplifier: Amplifiers: Atlas PA1001G, The product shall be a one channel 1RU half rack power amplifier and provide 100 Watts into a 70.7V load. The unit shall utilize rail tracking Class A/B topology and switch mode power supply technology. The front panel shall have Green signal presence LED's a Red limit status LED, recessed screwdriver adjustable bass and treble tone controls along with master level controls. The front panel shall have mains power switch with and power Blue "ON" and Red "Standby" status LED indicator. The rear panel shall have balanced inputs with removable phoenix style connectors and an input impedance of 20KΩ. The unit shall have unbalanced RCA input connections with input impedance of 10KΩ. Output terminations are made via phoenix style connectors. The unit shall have an audio sense turn-on from standby mode, with threshold adjustment of 1mV to 20mV. The unit shall have accessory AC socket with AC sense to turn the unit on from stand by to active mode with threshold adjustment of 1ma to 350ma. The unit shall draw 16 Watts in

standby mode. The unit shall incorporate dip switches to activate a 100Hz High-Pass filter and for pre / post VCA for Line Output. The unit shall have separate input level trim pots for the RCA inputs to allow mix summing with the balanced inputs. The unit shall have an input sensitivity of 320mv, frequency response of 30Hz – 20KHz (± 3 dB) and an average THD of .02%. The unit includes a mounting pole installation process via a sealed hole incorporated into the chassis design. The amplifier chassis hole shall accept a 1.5" mounting tube. The pole clamp system shall be included with the unit. An optional rack mount kit allows single or dual mounting in a 1RU high configuration. The unit shall be 8.5" (216mm) Wide x 1.75" (45mm) Height x 13.5" (343mm) Depth. The unit shall weigh 4.9lbs (2.2Kg). The unit shall be RoHS compliant. The unit shall be compliant with IEC/ UL60065. The unit shall be the Atlas Sound PA1001G.

N. 24 Port Gateways: IP Addressable Analog Gateway

1. IP Addressable Gateway provides integration with existing analog wiring infrastructure – consisting of shielded two-pair classroom field wiring. The Gateway provides the ability to reuse speaker wiring, speakers, and punch blocks to integrate analog infrastructure with IP platform.
2. Each Gateway will have 5 watts of power per port and 25 watts total per device.
3. Supports 24 classrooms that utilize 25 Volt speakers and all current Telecenter call switches for front office notification.
4. Supports minimum of 5 call switch priorities per classroom, capable of lockdown check-in functionality, while reusing existing shielded two-pair classroom field wiring.
5. Classroom intercom volume adjustable from Software interface.
6. Classroom paging volume adjustable from Software interface.
7. Configured to the school network and can be used in conjunction with IP Addressable Modules.

2.2 DEVICE PROTECTION

- A. Intercommunications speakers in the Gyms and the Wrestling Room shall be protected by wire guards.
- B. Wire guards shall be constructed of rigid steel wire with a white finish and shall be attached to building elements with tamper-resistant screws.

2.3 WIRE & CABLE

- A. General: Power and grounding conductors, including conductors for analog clock circuits, shall be minimum 12 AWG. All cable shall be suitable for Class 2 Circuit use. Minimum conductor size shall be #22 AWG, solid copper. Cable shall be rated CL2, CL2R or CL2P. CL2 cable shall not be used for riser cables. Cable installed in environmental air spaces shall be plenum rated.
- B. Intercommunications Cable: Intercommunications cable shall consist of one shielded pair with a drain wire and one unshielded pair, with an over-all jacket. Jacket color shall be gray. Increase conductor size in speaker cable above #22 AWG as required to limit voltage drop to 5% at farthest speaker.

2.4 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers shall be as listed above, and as follows:

1. Intercommunications System Equipment: Rauland, Valcom.
2. Cable: West Penn, Belden, Canare.

B. Substitutions may be considered only when submitted in conformance with Section 26 01 01.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to beginning rough-in or ordering equipment for the school intercommunications system, arrange a pre-installation meeting on the site between all parties involved in the intercommunications system installation, including the Electrical Systems Installer and the Owner's Representative. All parties shall review the school intercommunications system shop drawings, the manufacturer's installation instructions, system interface requirements, applicable regulations and any site conditions pertinent to installation of the school intercommunications system.
- B. Prepare minutes of the pre-installation meeting and distribute them to all parties in attendance at the meeting, and to the Owner's Representative and the Architect.

3.2 INSTALLATION

- A. Install the school intercommunications system in accordance with the manufacturer's recommendations. Locate equipment and devices as indicated.
- B. Final connections between the equipment and the wiring system shall be made under the supervision of a representative of the system manufacturer.
- C. Provide a flush-mounted backbox at the meter clock equipment rack location. Provide 36-inch service loops for all clock circuits in backbox.
- D. Provide backboxes matched to the devices. Where manufacturer's installation instructions indicate use of standard outlet boxes, boxes shall be in accordance with Section 26 05 31. Install plumb and aligned with building elements.
- E. Equipment and wiring terminals located outside communications equipment rooms or communications closets must be installed in suitable enclosures.
- F. Attach racks, cabinets, and backboxes securely to the building structure in accordance with Section 26 05 29.
- G. Provide bonding connections in accordance with Section 26 05 26 and manufacturer's installation instructions.
- H. Cables shall extend from the central equipment to the outlet locations in uninterrupted, continuous runs, without intermediate splices or taps. Each cable pair shall be free from shorts and grounds.
- I. Cables shall be arranged as shown on the shop drawings. Cable shall be installed in raceways. Raceways shall conform to the requirements of Section 26 05 33, and shall be bonded to the power system ground.

- J. Cables shall be routed so as to maintain a separation of at least 610 mm (24 in) from all heat sources and from ballasts, transformers, dimmers and other sources of electromagnetic interference. Avoid exposed cables in occupied areas or in areas where they might be damaged as a result of normal use of the area. Where two (2) or more cables run in parallel, they shall be bundled with cable ties.
- K. Care shall be exercised during cable installation not to damage cable insulation. Damaged cables shall be removed and replaced.
- L. All terminations, controls and outlets shall be clearly and logically labeled in accordance with the requirements in Section 26 05 53.
 - 1. Label each end of each conductor with Brady IDP printer with WML-311-292 labels.
- M. Provide equipment identification in accordance with Section 26 05 53.

3.3 MOUNTING HEIGHTS

- A. Back boxes shall be mounted at the heights indicated on the Drawings.

3.4 PROGRAMMING

- A. The intercommunications central exchange shall be programmed to function as specified under the description of system operation, including the interface to the Owner's telephone system and room designation assignments. Programming shall comply with direction received from the Owner's Representative.
- B. Programming shall be performed by an authorized manufacturer's representative.

3.5 ADJUSTMENT, TESTING & DEMONSTRATION

- A. Notify the Architect's Consultant and the Owner's Representative at least two (2) weeks in advance of the date of each test, to allow witnessing of the tests.
- B. Supply tools, instruments, gauges, testing equipment, protective devices, and safety equipment for adjustment, testing, and demonstration.
- C. During adjustment and testing, carefully record all settings and all test results, including expected test results, actual test results, and corrective actions taken. Records shall be submitted to the Architect's Consultant and included in the Operating and Maintenance Manuals.
- D. Test all system cable after installation and prior to connection to equipment. Tests to be performed shall include, but not be limited to, the following:
 - 1. Conductor continuity
 - 2. D.C. insulation resistance
 - 3. Freedom from shorts and grounds

- E. Make adjustments as necessary to balance the system and set volume levels in accordance with the direction of the Owner's staff. Adjustments to be performed shall include amplifier gain levels, speaker tap settings, VOX sensitivity, time-tone intensity and closeted volume control settings.
- F. Test all system features for proper function. Tests shall be conducted by a manufacturer's representative. Tests to be performed shall include, but not be limited to, the following:
 - 1. Verify proper operation of each program source.
 - 2. Verify proper operation of call stations.
 - 3. Verify proper operation of local volume controls.
 - 4. Verify proper operation of priority override functions.
 - 5. Verify proper setting of VOX sensitivity for two-way intercommunications.
 - 6. Verify that multiple audio channels can be activated simultaneously.
 - 7. Verify proper system activation from each telephone location.
 - 8. Verify proper system function in response to each dial-up access code.
 - 9. Verify intelligibility of paging announcements at randomly selected points in the building and outside opposite the exterior paging horns.
 - 10. Verify intelligibility of intercommunications and monitoring pick-up at randomly selected points in the building.
 - 11. Verify that the audio system operates free from spurious noises.
- G. Correct any deficiencies discovered as a result of the above testing, and completely retest the work affected by such corrections, with no additional compensation.
 - 1. After the system has been completed, tested and is operating properly, the manufacturer's representative shall demonstrate by actual usage, the proper operation of each control device and system function in the presence of the Owner's Representative. Demonstration shall include repetition of selected field tests, as well as additional adjustment or testing required to demonstrate that the system performs in accordance with the operational description as specified herein and the Owner's operational requirements.

3.6 ON-SITE TRAINING

- A. On-site training shall follow a written training plan, prepared in advance. The training plan shall outline the topics to be covered, the publications to be used, and the training schedule.
- B. Conduct two (2) hours minimum of training for the Owner's staff in operating the school intercommunications system. In addition, the Contractor shall supply two (2) hours minimum of further training for the Owner's maintenance personnel regarding maintenance of the system. Training time shall be extended as necessary to satisfy the Owner's Representative that all pertinent topics have been adequately covered.
- C. The training shall be conducted after the Operations and Maintenance Manuals for the Project are completed and available for use during the training session.
- D. Maintain a training sign-in sheet, upon which participants in the training session, including the instructors, shall record their names. The training sign-in sheet shall be dated.
- E. The training shall be conducted by a representative of the equipment manufacturer who is thoroughly familiar with the equipment and its features, and also with the Project. The training shall include instruction, field demonstration, and over-the-shoulder hands-on training. As a minimum, the training shall cover, but not be limited to, the following topics:

1. General overview of intercommunications systems, including purpose and principle of operation.
 2. System features, including expansion capability.
 3. Interface with the telephone system, including functions available through the telephone system.
 4. Interpretation of system outputs.
 5. Operation of system controls.
 6. Programming and configuration of the system.
 7. Recommended maintenance procedures and intervals.
 8. Detailed trouble-shooting instructions.
 9. Explanation of service agreement options.
- F. At the conclusion of the training session, obtain written sign-off from the Owner's Representative. Insert a copy of the training sign-in sheet into the Operating and Maintenance Manuals. Submit another copy of the training sign-in sheet to the Architect.

END OF SECTION 27 51 23

SECTION 27 53 13
WIRELESS CLOCK SYSTEM

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Transmission System
 - 1. System Controller with Receiver (Ethernet)
 - 2. Primary Internal Transmitter

- B. Wireless Synchronized Devices
 - 1. Analog Clocks
 - 2. Master Clock Synchronizer

1.2 RELATED DIVISIONS AND SECTIONS

- A. Division 26 00 00 - Electrical 120V for 60Hz grounded outlet required for System Master.
- B. Division 26 00 00 - Electrical 120V for 60Hz grounded outlet required for external transmitter
- C. Division 26 00 00 - Electrical 120V for 60Hz grounded outlet for each AC powered clock, Computer Time Synchronizer and Master Clock Synchronizer and other components

1.3 REFERENCES

- A. National Fire Protection Agency (NFPA) – 70, National Electric Code 2005

1.4 DEFINITIONS

- A. (GPS): Global Positioning System A worldwide system that employs 24 orbiting satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits atomic time.
- B. (CDMA): Code Division Multiple Access A time synchronization used in the mobile telephone industry.
- C. Ethernet: Provides time synchronization via SNTP (Simple Network Time Protocol) or Daytime Protocol from time server.

1.5 SUBMITTALS

- A. Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure showing available colors and finishes of clocks.
- B. Operating License (if required): Submit evidence of application for operating license prior to installing equipment. Furnish the license, or if the license has not been received, a copy of the application for the license, to the Owner prior to operating the equipment. When license is received, deliver original license to Owner.
- C. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.
- D. Manufacturer's Instructions: Submit complete installation, set-up and maintenance instructions.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing commercial timekeeping systems with a minimum of 10 continuous years of documented experience.
 - 2. Installer: Company with documented experience in the installation of commercial timekeeping systems.

1.7 REGULATORY REQUIREMENTS

- A. Equipment and components furnished shall be of manufacturer's latest model.
- B. System Controller, Transmitter and receiver shall comply with Part 90 of FCC rules, as follows:
 - 1. This device may not cause harmful interference.
 - 2. Transmitter frequency shall be governed by FCC Part 90.35.
 - 3. Transmitter output power shall be governed by FCC Parts 90 and 74.
- C. System shall be installed in compliance with local and state authorities having jurisdiction.
- D. Permits: Obtain operating license for the transmitter from the FCC. (FCC licensing can be coordinated by system manufacturer)

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver all components to the site in the manufacturer's original packaging. Packaging shall contain manufacturer's name and address, product identification number, and other related information.
- B. Store equipment in finished building, unopened containers until ready for installation.

1.9 FIELD CONDITIONS

- A. Clocks shall not be installed until painting and other finish work in each room is complete.

- B. Coordinate installation of GPS receiver and external antenna for access to the roof or exterior side-wall so that the bracket and related fasteners are watertight.

PART 2 – PRODUCTS

2.1 SYSTEMS DESCRIPTION

- A. A basic wireless timekeeping system, consisting of a system controller, a built-in or external transmitter, transmitter antenna, a means of receiving time synchronization (Ethernet), analog clocks, and accessory or optional components for expanding the system and its operations, that is capable of synchronizing clocks and computers throughout the facility on a daily basis.
- B. System shall synchronize all clocks to each other. System shall utilize Ethernet technology to provide atomic time to components. System shall not require hard wiring for its components except for AC power. Clocks shall automatically adjust for Daylight Saving Time per the Daylight-Saving time settings in the system controller.
- C. Clocks shall synchronize to +/- 1 second of the master clock displayed time.
- D. The system shall include an internal real-time clock reference so that failure of the time signal shall not cause the clocks to fail in indicating the correct time.
- E. The system shall incorporate a “fail-proof” design so that a temporary power interruption shall not cause failure of the system. Upon restoration of power, the system shall resume normal operation.
- F. The system shall include a optional notification pager or communication method to notify a local supervisor or maintenance personnel when the pager is active and the master is transmitting to verify signal reception.
- G. Clocks shall be AC powered for many years of maintenance-free operation.
- H. System instruction manual and equipment shall be available for building site transmitter signal reception diagnosis.

2.2 MANUFACTURER

- A. Wireless timekeeping system and its components shall be manufactured by the following acceptable manufacturers:
 - 1. Primex
 - 2. Valcom
 - 3. American Time

2.3 EQUIPMENT

- A. Wireless system controller: The system controller encoder shall incorporate a display and a keypad to provide the following features:

1. Time zone selection via the keypad and display for all USA time zones as well as others requiring programming by American Time and Signal. Includes all US time zones: Eastern, Central, Mountain, Pacific, Alaska and Hawaii.
 2. Automatic Daylight-Saving Time Adjustment can be enabled or disabled from keypad.
 3. Password protected Administrator Menu to set the date, local time zone, clock addresses, and other system parameters as needed.
 4. Database programming and administration using its keypad and LCD display
 5. The system controller shall contain an internal clock such that failure of reception from the time signal will not disable the operation of the clocks.
- B. Transmitter: Wireless transmitters may be internal or external, up to 350 Watts. The transmitter parameters shall be:
1. Frequency Range: multiple frequencies acceptable but are specific to manufacturer
 2. Transmitter output power: Internal 1 - 5 Watt or External 10-350 Watt in external case
 3. Transmission Range: Up to 50 miles radius (transmitter dependent)
 4. Radio technology: Narrowband FM, 12.5 KHz bandwidth
 5. Transmission format: POCSAG, digital one-way communication
 6. Digital Data rate: 512 - 2400BPS
 7. Operating range: 0 degrees C. to 70 degrees
- C. Antenna: shall be for indoor or outdoor applications. Antenna polarization shall be dependent on manufacturer's recommendation.
- D. Power supply: (included with master),
1. Input: 120-volt AC 50/60 Hz
 2. Output: 12-volt DC, 3 Amps
- E. Surge Protector:
1. Input: 120-volt AC 60 Hz +/- 1 Hz.
 2. Output: 120-volt AC, 550VA, 300 watts
 3. Surge Energy Rating: 700 joules with 10x1000uS pulse
- F. Clocks: Analog clocks, 12" diameter except for 16" diameter in Gym and Commons. Clocks shall be wall mounted. Analog Clocks shall have polystyrene black frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black, second hand is red. Other clock features shall be:
1. Clocks with no user mechanical adjustments. Run time of a half hour after power loss without losing time for AC versions.
 2. Time shall be automatically updated from the transmitter with a minimum of 1 time per day.
 3. Use AC power adapter without battery or step-down transformers.
 4. The clock shall have an ultra sensitive UHF receiver (better than -110dBm) and integrated internal antenna or other
 5. The clock will keep operating using its internal quartz clock in case of signal reception loss due to malfunction of the wireless system controller or transmitter.
 6. Provide wire guards where indicated on the drawings.

2.4 SYSTEM OPERATION AND STARTUP SEQUENCE

- A. System shall receive Atomic Time information from Ethernet that is connected to the system controller the system controller is a powerful multi-tasking device that is capable of sending accurate time information to synchronize all the system wireless clocks and accessories. The system can be monitored and programmed from the system controller keypad and LCD.
- B. Wireless System Controller Operation
 - 1. When power is first applied to the system controller, it checks for and displays the software version and looks for the time signal. Once the system controller has received the time, it sets its internal clock to that time. The system controller then starts to transmit its internal time according to the specified time synchronization mode. The system controller updates its internal clock every time it receives valid time data from the receiver.
- C. Clock Operation
 - 1. For AC powered clocks, apply AC power and follow manufacturers start up procedure. There is no need for any additional adjustment (the clock movement adjustment is fully automatic).
 - 2. After a few seconds of initial setup, the clock receiver will look for valid time transmission. The monitoring LED (if equipped) at the back of the clock will flash during that period of time. After a valid time data is received the monitoring LED will stop flashing, and the clock will adjust to the right time. The clock will look for valid time signals multiple times (minimum of once) each day and will synchronize to the correct time if needed.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
- B. Verify that 120-volt electrical outlet is located within 6 feet of location of transmitter and the outlet is operational and properly grounded.
- C. Verify that all 120-volt electrical outlets for the AC powered clocks are located at the exact installation point and the outlet is operational and properly grounded

3.2 FIELD INSPECTION

- A. Prior to final acceptance, inspect each system component to function properly and replace parts that are found defective.

3.3 MANUFACTURER SERVICES

- A. If needed, provide technical assistance as demonstrated in the manufacturer's system user guide, on product start up and system setup, to owners or installers representatives via phone, fax, or e-mail.

3.4 SYSTEM INSTALLATION

- A. Install in accordance with manufacturer's installation manual furnished with the system, for proper installation of each system component.

3.5 CLEANING

- A. Prior to final acceptance, clean exposed surfaces of all system components, using cleaning methods recommended by the manufacturer.

END OF SECTION 27 53 13

SECTION 28 00 00
INTEGRATED SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to Division 26.

1.2 CONDITIONS AND REQUIREMENTS:

- A. The Access Control, Intrusion Detection, Video Surveillance, and Lockdown/Entry Systems shown on the drawings will be provided and installed by an Integrated Systems contractor under direct contract with the Owner. **Intercom/Clock and Audio-Visual will be contractor-furnished and installed.**
- B. Any questions or clarifications concerning these bid documents, specifications and associated drawings are to be submitted to the owner's representative in writing via fax or email. Verbal questions will not be responded to. All written responses to inquiries will be done in the form of an addendum and issued to all registered bidders. Inquiries will not be accepted after (5) days prior to the closing date of the bid.
- C. Attend a post-award meeting at the School at a mutually agreed date and time to assure a complete understanding of the intent of these drawings and specifications. This meeting shall be attended by the owner's representative, the Integrated Systems contractor's Project Manager and Superintendent, and other such personnel as the Integrated Systems contractor may deem appropriate. The meeting is intended to assure a complete understanding of the intent of the design and the details of implementation.

1.3 SCOPE OF WORK:

- A. The Division 26 electrical contractor shall include (but not be limited to) raceways, sleeves, boxes, gutters, backboards, line and low voltage wire and cable, pull ropes (in unused conduits), grounding, connections and all other materials, equipment and labor required to make the systems ready for the Integrated Systems contractor to complete the technical installation. Refer to the Technology Component Systems Matrix (Matrix) at the end of the Electrical Specifications for scope of work detail.
- B. The Integrated Systems contractor shall furnish and install devices and equipment, terminate cabling to devices and equipment, provide system programming, final testing and system commissioning as listed as OFOI in the Matrix at the end of the Electrical Specifications.
- C. Coordinate closely with other contractors and sub-contractors on the project.
- D. Provide, connect and test all equipment and materials for the systems listed as CFCI or OFCI in the Matrix. All wiring shall be neatly tied or laced in cabinets and terminated on terminal strips provided for the purpose. Each conductor shall be identified by an approved marking system at each end just before entering the terminal strip. Conductor identification shall be repeated on the As Built drawings.

- E. Wherever materials, methods or placements of materials and equipment for the Integrated Systems installation is provided by others, coordinate that installation and assure that it is provided in such a manner as to enhance the final system operation.
- F. Coordinate installation in low voltage equipment rooms and other locations to avoid interferences.

1.4 INTENT AND INTERPRETATIONS:

- A. It is the intent of these plans and specifications to result in a complete system installation in accordance with all applicable codes, ordinances and this Division 28. If required, the installation shall also be fully interfaced, as described herein, with the existing facility and shall include cutting and patching as installation of this section.
- B. The drawings and specifications are intended to supplement each other and any details contained in one and not the other shall be included as if contained in both. Items not specifically mentioned in the specifications or noted on the drawings, but which are necessary to make a complete working installation shall be included.
- C. The word "provide" where used in this specification shall mean furnish and install.
- D. "Division 28", "Integrated Systems contractor" or "the contractor" refers to the contractor responsible for the installation of the systems described in these specifications.
- E. "Division 26" or "the electrical contractor" refers to the electrical contractor responsible for providing the raceway, cabling, and other supporting work for the integrated systems.
- F. The word "systems" refers to the Integrated Systems.
- G. The "Owner" refers to Central Valley School District.
- H. In the event that any discrepancies of any kind exist or required items or details have been omitted, notify the Owner's representative in writing of such discrepancies or omissions at least (10) ten working days prior to bid date. Failure to do so shall be construed as the willingness of the contractor to supply all necessary materials and labor required for the proper completion of this installation.

1.5 COORDINATION:

- A. *This installation requires extensive interfacing* - It is the responsibility of the Division 26 contractor to clarify any questions or discrepancies with the Integrated Systems contractor and/or owner's representative and to ascertain and verify all installation conditions about which he is unsure prior to commencing installation. No additional post bid allowances will be made.
- B. Verify the installation locations and elevations for all systems power requirements, junction boxes and outlets at the project.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

- A. Refer to the appropriate Division 26 specification section for the material installed.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION:

- A. Refer to the appropriate Division 26 specification section for the material installed.

END OF SECTION 28 00 00

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SECTION 28 31 00

FIRE ALARM SYSTEM

PART 1 – GENERAL

1.1 GENERAL

- A. Refer to Section 27 05 00, "Special Systems" for general requirements that apply to this section. Comply with all requirements of Section 27 05 00.
- B. The fire alarm system shall comply with all Spokane County Fire District 9 and State Fire Marshall requirements.
- C. The fire alarm system shall comply with Honeywell Silent Knight IFP-2000.

1.2 SCOPE OF WORK

- A. The contractor shall furnish and install a complete 24 VDC, electrically supervised, analog addressable fire alarm system with emergency communication as specified herein and indicated on the drawings. The system shall include but not be limited to all control panels, audio amplifiers, power supplies, initiating devices, audible and visual notification appliances, alarm devices, and all accessories required to provide a complete operating fire alarm system.
- B. All components shall be listed, labeled or approved for their application as fire alarm and carbon monoxide equipment by Underwriters' Laboratories, Inc.
- C. Comply with applicable provisions of current NFPA 72 standards, local building codes and meets requirements of local authorities having jurisdiction.
- D. System shall have dual path communication transmission configured for central monitoring by a U.L. listed Central Station.
- E. Provide a map of the school located at the remote annunciator with fire alarm information shown.

1.3 SYSTEM TYPE

- A. The system shall operate as a low-voltage, intelligent, addressable, voice alarm (English and Spanish), point identification fire management system. The fire detection and control system shall monitor intelligent (analog) and addressable (digital) devices, point identify the alarm location and transmit a signal to the monitoring agency.
- B. The fire alarm control panel shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on site programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes. All software operations shall be stored in a nonvolatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.

- C. The system shall provide carbon monoxide detection per the requirements of IBC 915.2.3. Alarm signals shall be transmitted to a UL Listed Central Station.

1.4 SYSTEM OPERATION

- A. System operation shall be such that actuation of any manual pull station, heat detector, smoke detector (except duct-type), sprinkler system water flow switch, or other approved device, shall cause the following to occur:
 - 1. All audible alarm speakers shall sound until silenced by the alarm silence switch at the control panel.
 - 2. All visual alarm indicating appliances strobes shall be activated.
 - 3. Any subsequent zone alarm shall reactivate the alarm indicating appliances.
 - 4. All doors normally held open by door control devices shall release after a ten second time delay.
 - 5. Transmit a supervised alarm signal to the security system control panel.
 - 6. Transmit a signal to the building energy management system to shut down all HVAC equipment.
 - 7. Annunciate a LCD message displaying the type, point label, condition and a location for the first alarm immediately without the need for operator response at control and remote annunciation panels. Subsequent events will be logged into queues for display by user selection.
 - 8. Close all combination fire/smoke dampers.
- B. An alarm shall be displayed on an 80-character alphanumeric display. The top line of characters shall be the point label and the second line shall be the device type identifier. The system alarm red LED shall flash on the control panel and the remote annunciator shall indicate the specific device in alarm. A subsequent alarm received from another zone after acknowledged shall flash the system alarm LED on the control panel and remote annunciator. The LCD display and the printer shall show the new alarm information. An alarm tone shall occur within the control panel and remote annunciator until acknowledged.
- C. The alarm-indicating appliance may be silenced by entering the locked control cabinet and operating the alarm silence switch. A subsequent alarm condition shall reactivate the signals.
- D. The control panel shall have a dedicated supervisory trouble condition indicator and acknowledge switch.
 - 1. The activation of any standpipe or sprinkler valve tamper switch, or a duct smoke detector shall activate the system supervisory service audible signal and illuminate the LED at the control panel and remote annunciator. Differentiation between device activation and open circuits or ground conditions shall be provided.
 - 2. Activating the acknowledge-switch will silence the audible signal while maintaining the supervisory service LED.
 - 3. For tamper switches, restoring the valve to the normal position shall cause the supervisory service LED to extinguish, thus indicating restoration to normal position.
 - 4. Transmit a trouble signal to the security system control panel.
- E. A manual evacuation switch shall be provided at the alarm panel to operate the systems alarm indicating devices. Other control circuits shall not be activated, however, a true alarm shall be processed as described previously.

- F. Alarm and trouble conditions shall be immediately displayed on the control panel from alphanumeric display at the remote printer and at the remote annunciator. If more than one alarm or trouble area is in the system, the operator may scroll to display new alarms.
- G. The control panel shall be capable of supplying a minimum of 3.5 amps at 24 VDC filtered and regulated. The power supply must be expandable to the total ampacity required by the system.
- H. All functions of the control panel shall be field programmable for maximum flexibility and expandability.
- I. The actuation of one of the smoke detectors in the Elevator Shaft, Elevator Equipment Room, or Elevator Lobby shall cause the system to send a signal to the elevator controller to recall the elevator.

1.5 POWER REQUIREMENTS

- A. The control panel shall receive 120 VAC power as noted on the plans via a generator-backed dedicated circuit.
- B. Provide 120V emergency power to all system amplifiers. .
- C. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in the normal supervisory mode for a period of 48 hours with five minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging shall be automatic.
- D. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control panel.

1.6 SHOP DRAWINGS

- A. The Contractor shall submit for approval complete system shop drawings. The shop drawings shall first be submitted for approval to the City of Spokane Fire Marshall within 30 days after contract award. Sufficient time must be allowed for these approvals prior to ordering equipment and installation of rough-in work.
- B. The shop drawings shall provide the following information (as a minimum):
 - 1. Title sheet with the following information: Owner's name, address and telephone number; manufacturer's name, address and telephone number; statement of scope of work, property tax account numbers for all parcels involved and legal description of property.
 - 2. Riser diagram showing all initiating and indicating circuits and the quantity of devices on each circuit.
 - 3. Floor plans showing all devices with their addresses and all terminal-to-terminal wiring.
 - 4. Battery calculations.
 - 5. System operating sequence.
 - 6. Wiring diagram for each type of device.
 - 7. Wiring schedule.
 - 8. Legend providing a detailed description and the catalog number of each type of device. All back box requirements shall be clearly identified.
 - 9. Shop drawings shall utilize the final room numbers established by the Owner, not the room and building numbers showing the architectural floor plan.

1.7 MANUFACTURER

- A. Control panels, expansion units, annunciators, and devices shall be manufactured by or be compatible with Silent Knight or Gamewell.

1.8 QUALIFICATIONS

- A. The System Vendor shall employ factory-trained technicians skilled in maintenance of fire alarm systems, and shall maintain a service organization with spare parts in stock within 50 miles of the Project site.
- B. The System Installer shall be an organization specializing in installation of low-voltage systems and have a minimum of 3 years experience in installing fire alarm systems similar in scope and complexity to the system required for this project.
- C. All personnel working on the fire alarm system shall be NICET Level 2 certified. Provide copies of licenses to the Owner before starting work at the site.

PART 2 – EQUIPMENT

2.1 CABLE

- A. All cabling shall be installed in metallic conduit or run in free air.

2.2 RACEWAYS

- A. Provide metallic raceways as specified in Section 26 05 33 for installation of cables. Raceway fill shall not exceed 40%. Raceways shall be colored red from the factory.

2.3 FIRE ALARM CONTROL PANEL

- A. Construction shall be modular with solid-state microprocessor based electronics. An 80-character minimum alphanumeric display shall indicate alarms, supervisory service conditions and any troubles. The panel shall have voice alarm and evacuation capability.
- B. The control panel shall contain the following:
 - 1. 80-character LCD display.
 - 2. Minimum of two indicating appliance circuits.
 - 3. Nonvolatile EEPROM memory.
 - 4. Multiple password levels.
 - 5. RS232 port for programming, printer and video display unit input/output.
- C. Programming: Programming shall be accomplished using a standard IBM compatible computer, either desk or laptop.
 - 1. The resident program shall be stored in nonvolatile EEPROM memory.
 - 2. The system shall have the capability to store the system program on a hard or floppy disk for future changes, upgrades or replacement.

3. Software will allow the user to reprogram system points, add system points, add or change point descriptions and update the data file. System output functions shall be field programmable to allow custom operations.
- D. The control panel shall have Dual Path Communication for Central Station Reporting with the Primary path as cellular and Secondary path as IP.

2.4 PERIPHERAL DEVICES

- A. Manual Stations: Shall be double-action and shall be constructed of die-cast aluminum with raised white lettering and a smooth high-gloss red finish. When the station is operated, the handle shall lock in a protruding manner to facilitate quick visual identification of the activated station. The station shall be capable of being reset using a screwdriver. Stations requiring a special key for operation shall not be permitted.
- B. Smoke Detectors: Shall be listed to UL Standard 268 and shall be documented compatible with the control equipment to which it is connected. The smoke detectors shall be photoelectric type with a plug-in base and visual indication of detector actuation. All detectors are to be addressable and intelligent with the capability of alarm verification, sensitivity adjustment by detector and maintenance alert circuitry.
- C. Duct Smoke Detectors: Shall be photoelectric type and shall operate at air velocities of 300-2000 feet per minute. An integral filter system shall be included to reduce dust and residue accumulation. An airflow monitor shall be included to indicate the presence and direction of airflow through the detector. Each duct detector will be provided with an addressable monitor module for individual identification at the control panel.
- D. Thermal Detector: Addressable combination rate-of-rise and fixed-temperature (135°) detector employing electronic, dual thermistors.
- E. Heat Detector: Nonaddressable 135° or 190° (as shown on drawings) fixed-temperature detector employing a fusible alloy element. Provide monitor module(s) to monitor detectors within a specific area.
- F. Projected Beam Smoke Detector: Unit shall consist of a transmitter and receiver capable of operating in a temperature range of -22°F to 131°F. The detector shall have a bank of four alignment LEDs on both the transmitter and receiver to align the units without special tools. Detectors shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on lenses. Provide heavy-duty wire guards over each transmitter and receiver. Provide a Remote Indicator/Test station at a serviceable height (84-96") within direct sight of beam detector. Provide wire guard over each.
- G. General Alarm Signals: Shall be electronic speaker/strobes. The units shall have adjustable volumes. The strobes shall produce 8,000 peak candlepower at one flash per second. Mounting shall be flush type or as shown on the drawings. Screw terminals shall be provided for in/out field wiring of up to #12 gauge wire. All models shall be UL listed for fire protective service and must meet current ADA requirements. All speaker/strobes shall be synchronized.
- H. Remote Annunciator: Shall be alphanumeric type with controls to allow silencing, resetting and activating of alarms. Operation of the indicating LEDs shall be through programmable outputs from the main fire alarm control panel. Communication between the main fire alarm control panel and the remote annunciator shall be via an RS232 link. Zone schedule shall be coordinated with the Owner or his/her representative.

- I. Monitor Modules: Provide addressable monitor modules as required for devices that do not have integral intelligence.
- J. Water Flow Switches: Provided by Division 23 and wired by Division 26. Coordinate requirements.
- K. Sprinkler Valve Tamper Switches: Provided by Division 23 and wired by Division 26. Coordinate requirements
- L. Magnetic Door Holders: Provided by Division 08 and wired by Division 26. Holders shall be powered from the fire alarm system. Coordinate requirements.
- M. Guards: Fire alarm signals and manual stations installed in the Gymnasium shall have guards. Guards for manual stations shall allow ready access either through the front of the guard or by lifting a hinges guard. Guards shall be formed steel with flanges for attaching to wall surface. Guards shall have a matte white finish.
- N. Sprinkler Bell: Bell shall be 120 VAC powered via relay controlled by the fire alarm panel.
- O. Carbon Monoxide Detectors: Shall be listed to UL Standards and shall be documented compatible with the control equipment to which it is connected. All detectors are to be addressable and intelligent with the capability of alarm verification, sensitivity adjustment by detector and maintenance alert circuitry.

PART 3 – EXECUTION

3.1 GENERAL

- A. All personnel working on the fire alarm system shall be NICET Level 2.
- B. Fire alarm equipment and devices shall be protected from dust during construction. Smoke detector heads shall be installed only after dust-producing activities have completely ceased, building surfaces have been finished, and clean-up by all trades has been completed. The plastic covers shipped with the detectors are for protection during shipping and storage and are not suitable to protect detectors from construction dust.
- C. Identify both ends of all wiring and cabling with zone, area, floor, etc. to match identification on wiring diagram. Wire markers shall be located adjacent to connection points where easily visible.
- D. Cable marking system shall be made using a Brady ID PAL printer with 3/4" labels or approved labeling method.
- E. Locate ceiling-mounted smoke detectors at least 48" from supply air diffusers, and at least 12" from air grills.
- F. Locate detectors so they are readily accessible for testing.
- G. Where smoke detectors or duct smoke detectors are located above ceilings or otherwise are not readily visible, provide remote indicator lights equipped with key operated test switches. Provide a permanently attached placard indicating the location of the detector and the area served.

- H. Provide isolated loop circuit protectors on all initiating, indicating, and signaling circuits extending beyond the building perimeter, including addressable loop and annunciator communication lines and associated shielding. Locate the protectors as close as practical to the point where the circuits enter and leave the building. Connect the protector ground terminal to the building grounding system with a grounding conductor no smaller than 12 AWG.
- I. Maintain consistent color-coding of conductors throughout the project. Color coding shall be as follows:
- J. Horn circuit: + Red, - Black
- K. Initiating Circuit: + Orange, - Brown
- L. Control Circuit: + Blue, -Yellow
- M. Provide a smoke detector at every NAC power extender location.

3.2 PROGRAMMING

- A. Programming shall be performed by an authorized manufacturer's representative.
- B. Relay names in the program shall note the location and what they control.
- C. All device point names shall be descriptive of the device location, and if the number of characters in the field allows, the device description. Default point name assignments are not acceptable. The nearest room number (must have readily visible room number signage) shall be given first, followed by the room description as data entry space allows. An example is "Room 231 – Science lab". For corridors, hallways, and stairways the device shall be labeled as follows:
- D. Lounge Area – by Rm 115
- E. Gallery – by Rm 102B
- F. Leadership – by Rm 102
- G. The "Rm" notation may be left off if the number of characters is limited in the programming field. Also, corridors and hallways may be abbreviated as necessary (Corr & Hall) to fit.
- H. Provide the Owner a copy of the system program in electronic format on CD-ROM media. Also provide all auxiliary programs and patch cables required to load the program into the fire alarm system memory.

3.3 TESTING

- A. Notify the Owner's representative at least one (1) week in advance of the dates when system testing and demonstration will be performed, so test may be witnessed.
- B. When testing the system, lock out all HVAC equipment from shutdown. Failure to comply may result in contractor liability for equipment damage.

3.4 ON-SITE TRAINING

- A. A training plan shall be submitted in advance for acceptance. The training plan shall outline topics to be covered, publications to be used, and the training schedule.
- B. The Contractor shall provide eight (8) hours minimum of training for the Owner's Staff in the operation of the fire alarm system. In addition, the Contractor shall provide eight (8) hours minimum of further training for the Owner's maintenance personnel in the maintenance of the fire alarm system. Training time shall be for the Owner's maintenance personnel in the maintenance of the fire alarm system. Training time shall be extended as necessary to satisfy the Owner's representative that all pertinent topics have been adequately covered.
- C. The training shall be conducted by a representative of the System Vendor who is thoroughly familiar with the equipment and its features, and also with the installation on this project. The training shall include instruction and over-the-shoulder hands-on training. As a minimum, the training shall cover, but not be limited to, the following topics:
 - 1. Interpretation of system outputs (signal tones, annunciator displays, printouts)
 - 2. Operation of system controls (fire drill, acknowledge, silence, rest)
 - 3. Programming of the system
 - 4. Recommended and required maintenance procedures and intervals
 - 5. Detailed Trouble-shooting instructions for each trouble condition annunciated by the system.
 - 6. Explanation of service agreement options
 - 7. Installer level programming
- D. General overview of system features, include expansion capability:
 - 1. Interpretation of system outputs (signal tones, annunciator displays, printouts)
 - 2. Operation of system controls (fire drill, acknowledge, silence, rest)
 - 3. Programming of the system
 - 4. Recommended and required maintenance procedures and intervals
 - 5. Detailed Trouble-shooting instructions for each trouble condition annunciated by the system.
 - 6. Explanation of service agreement options
 - 7. Installer level programming
- E. On site training with system checkout shall be conducted after all items below are completed and submitted to the Owner prior to the training session:
 - 1. As-built drawings (3 copies) – see 3.12 Record Documents for requirements.
 - 2. Shop drawings including battery calculations, notification appliance circuit voltage drop calculation, wire size, etc.
 - 3. Documented current draws and voltages at the batteries for each panel and also at the furthest device on each notification circuit during full alarm condition. Document the battery voltage and amp-hour rating of batteries affiliated with these measurements.
 - 4. Operation and Maintenance manuals for the system – 3 copies
- F. Work with the school district's electrical shop foreman to install/update the fire alarm system's software on three (3) district electrical shop laptop computers.

3.5 FINAL ACCEPTANCE

- A. Only after satisfactory test of entire fire alarm system installation, including the work in the existing building, in the presence of the Owner's representative and the Fire Marshal, and after receipt of the manufacturer's representative's letter of certification as specified.

3.6 LABELING

- A. Label all smoke detectors, heat detectors, pull stations, control relays, etc. with ID number using electronic labeling printer (similar to those manufactured by Brother). Label shall be 1/4" red lettering on white background. Label shall match as-built drawing and programming entries.
- B. Label all batteries with installation date using electronic labeling printer.
- C. All duct detectors shall be labeled with a phenolic nameplate as specified in Section 26 05 53. Nameplate shall indicate the identification number of the fan/HVAC unit and the detector address.
- D. All remote alarm indicators shall be labeled with a phenolic nameplate as specified in Section 26 05 53. Nameplate shall indicate the identification number of the fan/HVAC unit and the detector address.

3.7 DUCT DETECTOR INSTALLATION

- A. Provide a duct type smoke detector at each supply and return fan with a capacity greater than 2000 CFM. Install detectors ahead of return fan fresh air intake and down stream from supply fan filters.
- B. Install duct detector sampling tubes such that they extend through the duct. Install a removable cap on the end of the sampling tube which can be removed and used as a smoke injection point to facilitate detector testing.
- C. Install duct detectors such that they are readily accessible for testing.

3.8 FAN SHUTDOWN

- A. Provide all required connections from duct detector auxiliary SPDT relay to fan motor starter to shut down fan upon activation of the fire alarm system.
- B. Provide the necessary connections to shut down the associated supply fan when the damper goes into alarm.

3.9 FIRE SMOKE DAMPERS (FSD)

- A. Provide relays with 120-volt rated contacts controlled from the FACP such that the dampers close upon fire alarm and are powered open once the alarm is cleared. Provide all required connections from the relays to the fire smoke dampers. Refer to mechanical drawings for quantity and location of dampers.
- B. Provide the necessary connections to shut down the associated supply fan when the damper goes into alarm.

3.10 AUTOMATIC REPORTING

- A. Connect the fire alarm control panel for reporting as follows: One FPLP cable to the Bosch Security panel for alarm, trouble, and supervisory; one Qwest telephone line wired to seize control of the line (Qwest line is the backup). The system shall report to the School District's Monitoring Center. The system shall transmit alarm, supervisory and trouble conditions with the alarm signal having priority. The output shall match the Central Reporting Agency protocol with final verification/approval of Spokane Public Schools facilities and maintenance shop.

3.11 SPARE CAPACITY

- A. Initiating Circuits: Each initiating circuit shall be configured such that a minimum of ten additional initiating devices (smoke detectors, thermal detectors, pull stations etc.) can be added.
- B. Indicating Circuits: Each indicating circuit shall be configured such that a minimum of five additional indicating devices (strobes, horn/strobes, strobes, etc.) can be added.

3.12 RECORD DOCUMENTS

- A. The Contractor shall provide as-built shop drawings (hard copy & disk) at the end of the project. The drawings shall include a floor plan showing the as-built location of all equipment, devices, relays, and smoke dampers with and ID number of each device. Also show zone boundaries and riser and wiring diagrams for the system. Relays shall be noted as to what they control.
- B. O&M manuals with system and equipment details and diagrams.

END OF SECTION 28 31 00

SECTION 28 31 13

INTRUSION ALARM-ACCESS CONTROL SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to work specified in this section.
- B. Refer to Division 28, Section 28 05 00, "Common Work Results for Electronic Safety and Security," for general requirements that apply to this section. Comply with all requirements of Section 280500.
- C. Refer to Division 27, Section 27 15 00, "Communications Cabling." Comply with all requirements of this section.
- D. Related sections:
 - 1. Section 280010: General Provisions
 - 2. Section 280500 Common Work for Electronic Security & Safety
 - 3. Section 260533: Raceway & Boxes
 - 4. Section 260529: Hangers & Supports
 - 5. Section 260533: Identification

1.2 SUMMARY

- A. Provide additional Honeywell Omniprox Card Readers to be incorporated into the existing access control system and security system with a digital communicator for digital transmission to a Remote Reporting Agency. The system shall be an extension of the existing school's security system.
- B. Provide additional portal licenses to support the addition of the project.
- C. Program the intrusion detection-Access Control systems in accordance with directions received from the Owner's Representative.
- D. Adjust and test the intrusion detection-Access systems and demonstrate the system to the Owner's Representative.
- E. Instruct the Owner's staff in operating the systems and recommended maintenance procedures.

1.3 REFERENCES

- A. Underwriters Laboratories (UL):
 - 1. UL 609 – Local Burglar Alarm Units and Systems
 - 2. UL 1635 – Digital Burglar Alarm Communicator System Units

3. Federal Communications Commission (FCC):
 - a. Code of Federal Regulations Title 47 - Part 15 – Radio Frequency Devices.
 - b. Code of Federal Regulations Title 47 - Part 68 – Connection of Terminal Equipment to the Telephone Network.

B. National Fire Protection Association (NFPA):

1. NFPA70 – National Electrical Code.

1.4 SCOPE OF WORK

- A. Provide new access control devices, wiring, installation, testing, setup and owner training to be incorporated with building's existing security system for the purposed remodeled building areas. The new card readers in the building remodel work shall be base bid.

1.5 SYSTEMS DESCRIPTION

- A. The Access Control System (ACS) shall provide active door entry management by credential readers at selected entry points and Owner issuance of credentials to users to allow authorized entry as to be determined by the Owner.
- B. System shall interface with the building lockdown pushbutton and networked lighting control system.

1.6 SOFTWARE SERVICE AGREEMENT ACCESS CONTROL

- A. Technical Support: Beginning with final project acceptance, provide software support for two years for the Access Control System.
- B. Upgrade Service: Update software to latest version at project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software. Provide 30 days' notice to Owner to allow scheduling and access to system, and to allow Owner to upgrade computer equipment if necessary.

1.7 QUALIFICATIONS OF SYSTEM VENDER

- A. The System Vender shall be a manufacturer-authorized dealer/distributor for the intrusion detection system equipment manufacturer and for the Access Control system manufacturer, with the capability of offering factory-certified service at the Project site, both during and after the warranty period.

- B. The System Vendor shall employ trained technicians skilled in maintenance of intrusion detection systems and Access Control systems and shall maintain a service organization with spare parts in stock within 150 miles of the Project site. The technicians shall be licensed as required by local and State jurisdiction to perform work on limited-energy systems. The service organization shall have the equivalent of 5 years' experience in servicing intrusion detection systems and shall be capable of responding to service calls within 24 hours. Furnish references upon request. The systems vendor shall be an authorized Engineered Systems Distributor (ESD) for Honeywell Prowatch Systems. The system vendor shall also be an authorized for PW Series access control system.

1.8 QUALIFICATIONS OF SYSTEM INSTALLER

- A. The System Installer shall be an organization specializing in installation of low-voltage systems and having the equivalent of 5 years' experience in installing intrusion detection systems similar in scope and complexity to the system required for this Project. The organization shall employ factory-trained technicians skilled in installation of intrusion detection systems, who have been trained by the intrusion detection system manufacturer and the Access Control system manufacturer in the installation of the equipment provided on this project. The technicians shall be licensed as required by the local and State jurisdictions to perform work on limited energy systems, and shall have successfully installed at least two (2) other intrusion detection system of the same type, size, complexity and manufacturer as that provided for this Project. The previously installed system shall have been in operation for at least 12 months. Furnish references upon request.

1.9 SUBMITTALS

A. GENERAL:

- 1. Comply with Division 28, Section 28 05 00, "Common Work Results for Electronic Safety and Security."

B. PRODUCT DATA

- 1. Submit for each type of product indicated.

C. SHOP DRAWINGS

- 1. Include complete system riser showing all ACS devices and network components.
- 2. Include typical installation details for each ACS device and network component.
- 3. Indicate on shop drawings the locations of each card reader and all doors with ACS equipment. Show size and route of cable and conduits.
- 4. Indicate on shop drawings the locations of each magnetic contact, motion sensor, keypads and all other intrusion system devices.
- 5. Indicate on shop drawings all interconnecting wiring between control equipment and peripheral devices for both systems, including wire routing, wire type and manufacturer catalog number, and wire size and conductors.

- D. Submittals shall include manufacturer data sheets for all major system components.

1.10 INFORMATION FOR OPERATING & MAINTENANCE MANUALS

- A. Submittals: Information submitted for review, updated to record any changes.
- B. Operating Instructions: Supply a detailed narrative description of the system operation. Indicate expansion capability, application conditions and limitations of use. Include manufacturer's installation and operating instructions.
- C. Maintenance Instructions: List replacement parts, including source. Indicate recommended maintenance and testing procedures, and the intervals involved for each. List all individual system components that require periodic maintenance. Detail trouble-shooting procedures. Include a service directory with names and telephone numbers for use in obtaining service.
- D. Program Record: Provide record sheets listing the panel programming selections implemented.
- E. Warranty: Manufacturer's or Vendor's warranty certificate.

PART 2 - PRODUCTS

2.1 INTRUSION SYSTEM

- A. Manufacturer: Vista
- B. Control Panel: 250BT Security Panel
- C. At a minimum, the control panel shall provide the following:
 - 1. Expansion to a total of at least 10,000 user codes with 80 user profile definitions
 - 2. Sixteen (16) independent door/keypad addresses, each with four zones
 - 3. Twenty (20) holiday dates for custom holiday scheduling by area
 - 4. A total event buffer of at least 10,000 events
 - 5. Four (4) shift schedules per area
 - 6. A total of at least 100 programmable output relay schedules
 - 7. Thirty-two (32) individual reporting areas
 - 8. Built-in bell and telephone line supervision
 - 9. Four to Six-digit user passcodes
- D. A battery test shall be automatically performed to test the integrity of the standby battery. The test shall disconnect the standby battery from the charging circuit and place a load on the battery. This test shall be performed no more than every 180 seconds.
- E. The control unit shall be capable of operating and supervising notification appliance devices as well as addressable initiating detection devices and an integrated supervised dual line digital communicator.
- F. Control unit must be 'Flash ROM' updatable, and program must be held in non-volatile RAM. The panel shall be able to function while the update is in process.
- G. Serial Interface: The control panel shall be capable of a serial interface to output information to a standard serial printer or serial interface to a communication port on a standard computer. Through control panel programming the system shall include a provision to allow the selection of which reports are to be output.

H. Power Supplies:

1. Power supplies for the control unit shall operate from 120 VAC, supplied at the respective protected areas. Standby batteries shall be supplied to power the system in the event of a utility power failure. Batteries shall be sized to provide 105% capacity for eight hours. Standby batteries shall be sealed lead-acid. Power supplies shall be all solid state.
2. Controls shall be designed to maintain full battery charge when alternating current is available. Batteries shall be recharged to 85% capacity within 24 hours from battery use. The system shall be automatically transferred to battery power upon loss of alternating current power and return to alternating current power upon restoration. Intrusion alarms shall not be initiated during switchover; a signal shall be initiated upon failure of battery or alternating current power.
3. Approved power supplies shall meet or exceed the following power supply model specifications:
 - a. U.L. Listed Honeywell PW6K2E2PS Power Supply with transformer and enclosure for system peripheral devices.

I. Software:

1. The system shall interface with computer software with the capability to fully program the panel by connecting to the panel through:
 - a. Direct cable connection interface card
 - b. Receiver phone line connection
 - c. Standard phone line connection
 - d. Ethernet network connection
 - e. Network connection across the internet
2. The system shall interface with computer software capable of monitoring and logging all events.
3. The system shall interface with computer software capable of exporting reports in the following file formats:
 - a. Excel Spreadsheet (*.xls)
 - b. Rich Text (*.rtf)
 - c. Windows Metafile (*.wmf)
 - d. Text (*.txt)
 - e. Comma-separated (*.csv)
 - f. HTML document (*.htm)
4. The system shall interface with computer software capable of printing custom, filtered reports including:
 - a. All Events
 - b. Zone Action
 - c. Arming/Disarming
 - d. Area Late to Close
 - e. User Code Changes
 - f. Door Access Granted
 - g. Door Access Denied
 - h. Opening/Closing Schedule Changes
 - i. System Monitors
 - j. System Events

J. Functional Descriptions:

1. The system areas and zones shall be programmable, and the system shall store, log, display, and transmit specific custom designations for system areas, zones, and user names.
2. The system shall be constructed of sensing components provided directly by the system manufacturer, such as power supplies, motion detectors or door position switches.
3. The system shall support user interaction by way of a keypad, web browser or system software, using integrated or auxiliary devices provided by the system manufacturer.
4. The system shall support controller zone input connections, system keypads, system zone expansion modules, and wireless zone input modules, and must support zone input connections by way of at least two competitive products. The system shall offer a seamless integrated compatibility with hardwire and/or wireless zone expansion equipment for at least 200 wireless zones and/or a maximum of 574 hardwired zones.
5. The system shall be capable of offering at least five zone expansion buses, each of which can support the connection of up to 15,000 feet of four-wire cable.
6. The system shall provide a seamless capability to provide a minimum of 500 addressable relays, which can be located at any connection location upon a zone expansion bus.
7. System relay outputs shall have the capability of being triggered as a result of a command from the user interface, changes in system status, changes in zone status, or by a programmable schedule.
8. System relay output states shall be programmable for momentary, maintained, pulsed, or must follow the state of an associated system zone input.
9. The system shall be completely programmable either locally from a keypad or remotely through a standard dial-up, and network connections by way of a LAN, WAN, and/or by way of the internet.
10. The control unit shall be completely programmable remotely using annunciators, personal computer, and/or using upload/download software that communicates using SDLC 300 baud, 2400 baud, or IP addressed at a network.
11. The control unit shall be equipped with an anti-reversing circuit breaker to prevent damage due to accidental reversal of battery leads.

K. Input/Output Capacity:

1. This system shall be capable of monitoring a maximum of 574 individual zones and controlling a maximum of 502 output relays.
2. The control panel shall have, as an integral part of the assembly, 2 SPDT Form C relays rated at 1 amp at 30 VDC and four open collector 12 VDC outputs rated at 50mA each. It shall also have the capacity of a maximum of 125 output expander modules with 500 switched ground, open collector outputs, 50mA maximum and 502 auxiliary relays (Form C rated at 1.0 amp at 30 VDC).
3. The panel shall also provide 100 programmable output schedules, and include an integral bell alarm circuit providing at least 1.5 amps of steady, pulsed, or temporal bell output. Output type shall be programmable by zone type. Relays and voltage outputs shall be capable of being independently programmed to turn on and/or off at selected times each day.

- L. User/Authorization Level Capacity: The system shall be capable of operation by 10,000 unique Personal Identification Number (PIN) codes with each code having one (1) ninety-nine (99) custom user profiles. This allows for limitation of certain functions to authorized users. The operation of all keypads shall be limited to authorized users.

2.2 ELECTRONIC COMPONENTS

- A. All system electronic components shall be solid-state type, mounted on printed circuit boards. Light duty relays and similar switching devices shall be solid-state type or electromechanical.
- B. The panel shall have an overcurrent notification LED that lights when devices connected to the keypad bus and LX-bus(es) draw more current than the panel is rated for. When the overcurrent LED lights, the LX-bus(es) and keypad bus are shut down.

2.3 ENCLOSURE

- A. Housings: Power supply enclosure, terminal cabinets, control units, and other component housings, collectively referred to as enclosures shall be so formed and assembled as to be sturdy and rigid. If sheet steel is used in the fabrication of enclosures, it shall be not less than an 18 gauge door with a 20 gauge box frame. Where exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent ready removal. Doors having a latch edge length of less than 24 inches shall be provided with a single lock. Where the hinged door latch edge is 24 inches or more in length, doors shall be provided with three-point latching device with lock; or alternatively with two locks, one located near each end. For SCIF and High Security applications an attack proof enclosure with proper tamper UL listed for use with the XR550/XR550N/SR550E shall be used.

2.4 PERIPHERAL DEVICES

- A. Keypad: 6160 Alpha Display Key Pad. The keypads shall be capable of the following:
 - 1. Performing all system arming/disarming functions via passcode entry.
 - 2. Perform all system arming/disarming functions via internal proximity reader.
 - 3. Being assigned to any partition.
 - 4. 32 character display.
 - 5. Backlit keys for visibility.
 - 6. Zones and system events displayed in plain English.
 - 7. Functions performed by entering security code plus command.
- B. Sirens: Heavy-duty Mylar diaphragm speaker with 2-channel siren driver in semi-flush housing with bone white high-impact plastic grille. Frequency range shall be 700 to 2000 Hz. Siren shall produce both yelp and steady tones. Sirens shall be equivalent to: Honeywell Wave2 series.
- C. Motion Sensors: Sensor shall use sensor data fusion technology that uses a sophisticated software algorithm to gather signals from five sensors: two pyro-electric sensors, range adaptive radar, a room temperature sensor, and a white light level sensor. The microcontroller analyzes and compares the sensor data to make intelligent alarm decisions. Tri-focus optics technology shall use optics with three specific focal lengths: long-range coverage, middle-range coverage, and short-range coverage. The detector shall apply the three focal lengths to 86 detection zones, which combine to make 11 solid curtains of detection. Tri-focus optics technology shall include two pyro-electric sensors, to deliver twice the standard optical gain. The sensors shall process multiple signals to deliver precise performance virtually free of false alarms. The microwave transceiver shall automatically adjust its detection thresholds based on input from the PIR sensors to integrate the target audience distance information from the PIR to significantly reduce false alarms from the microwave Doppler radar. The detector shall send a supervision trouble signal if microwave reflective material is placed within (1 ft) of the detector. The detector shall provide single technology coverage if the microwave subsystem fails. An internal light sensor shall measure the level of light intensity directed at the face of the detector.

Sensor data fusion technology shall use this information to eliminate false alarms from bright light sources. Coverage area may be selected via a DIP switch to select (60 ft x 80 ft or 25 ft x 33 ft) coverage. The detector shall automatically adjust PIR sensitivity to identify human intruders at critical temperatures. Dynamic temperature compensation shall detect human body heat accurately, to avoid false alarms, and deliver consistent catch performance at all operating temperatures. In the event of removal of the cover or attempts to separate the detector from the wall, a normally-closed contact shall open to alert the control panel. The LED brightness shall adjust automatically to the surrounding light level. A blue light-emitting diode (LED) shall indicate dual alarms and activates during a walk test. A yellow LED shall indicate microwave alarms, and a red LED shall indicate PIR alarms. Users shall be able to locally enable or disable the walk test LED through the DIP switch. A sealed optic chamber shall provide immunity to drafts and insects, reducing false alarms. Sensor shall have small animal immunity to animals less than (10 lb), such as rodents. Wall mounted sensors shall use Bosch B328 Gimbal mounts attached to single-gang box opening. Ceiling mounted sensors shall use Bosch B800 mounts attached to single gang box opening. Sensor shall be Bosch ISC-PDL1-W18 Professional Series.

- D. Door Contact Switches, Magnetic Type: Contacts shall be designed for flush mounting in steel door frames. Contacts shall be 3/4" diameter for steel door frames. Contacts shall be rated for a gap of not less than 1/2". Each contact shall be hermetically sealed for long term operation and rated for 10,000,000 operating cycles. Switch contacts shall use screw terminal wire connections. Switch contacts shall be of the reed blade type with rhodium plating eliminating cold-welding; sticking and resistance build-up. Magnetic door contact switches shall be equivalent to: Nascom N1178CTB/ST.
- E. Door Contact Switches, Overhead Door Type: Magnetic rail mounted contacts and magnets. Each contact shall be hermetically sealed for long term 10,000,000 cycle operation. Switch contacts shall be of the reed blade type with rhodium plating eliminating cold-welding; sticking and resistance build-up. All switches shall be 100% factory tested prior to installation. Units shall be made from aluminum bar stock to prevent damage from ordinary usage. Contacts shall be provided with a stainless steel armored cable and shall be designed to accommodate door gaps of up to 3 inches. Overhead door contact switches shall be equivalent to: Nascom N505AUTM/ST for 2 1/4 inch tracks, and N505AUTMC/ST for 3 inch tracks, with 26 inch armored cable and wires.
- F. System Zone Expander Interfaces: Install zone expansion modules for connection of all peripheral intrusion contacts and motion sensors, to provide point-identification of each device or device group. Device groups shall be no larger than the multiple contacts on doors physically grouped together.
- G. Relays shall function to turn off all interior lighting upon presentation of a valid credential to ARM the system at a keypad. Relays shall also function to turn on all corridor lighting upon an ALARM condition created by an intrusion.

2.5 ACCESS CONTROL SYSTEM

- A. Honeywell Vista-250BPT Alarm Control Panel system.
- B. The Access Control system shall be an extension of the existing system deployed in the College.
- C. The Access Control system is implemented through network appliance architecture with a three-tiered modular hardware hierarchy and embedded three-tier software architecture.

- D. The Access Control system shall integrate, within a browser interface, access control, alarm monitoring, video monitoring, and temperature monitoring applications. These applications shall be embedded in a three-tier software architecture.
- E. All equipment and materials used shall be standard components, regularly manufactured, and regularly utilized in the manufacturer's system.
- F. All Access Control systems and components shall have been thoroughly tested and proven in actual use.
- G. All Access Control systems and components shall be provided with an explicit manufacturer warranty of one year for software and two years for hardware.

2.6 OVERALL ACCESS SYSTEM CAPABILITY

- A. The Access Control system monitors and controls facility access, and performs alarm monitoring, selected camera and video monitoring, communications loss monitoring, and temperature monitoring. The system also maintains a database of system activity, personnel access control information, and system user passwords and user role permissions. The system is controlled from a web browser and requires no software installation or client licenses. The system provides control and access to users on Local Area Networks (LAN), Wide Area Networks (WAN), wireless networks, and the Internet. The system provides email and/or text message alerts for all alarm conditions and threats.
- B. Widget Desktop: The Access Control system provides a widget-based user interface that enables users to create custom monitoring layouts by selecting and arranging widgets on a desktop.

2.7 HARDWARE REQUIREMENTS

- A. The Access Control system employs a modular hardware concept that enables simple system expansion and utilizes a three-tiered hardware hierarchy. The system is manufactured by Honeywell Security Corporation.
- B. The Application blades shall interface with the network controller through the Network Node. The Application blades shall be blade-style circuit cards. There shall be four types of Application blades:
 - 1. Access Control blade: shall support 2 readers (input devices such as keypads, RFID devices or Biometric readers), 4 supervised inputs and 4 relay outputs.
 - 2. Supervised Input blade: shall support 8 supervised inputs. Supervised input connectors are 2-pin. The system shall support a wide variety of input supervision types including normally-open circuit and normally-closed circuits, and zero, one or two resistor configurations.
 - 3. Relay Output blade: shall support 8 relay outputs. Relay output connectors are 3-pin. Both normally-open circuit and normally-closed circuit output devices are supported. The relay outputs shall support any output devices that operate on the following maximum electrical ratings: 30 Volts DC or AC, 2.5 Amps inductive or 5.0 Amps non-inductive.
 - 4. electrical ratings: 30 Volts DC or AC, 2.5 Amps inductive or 5.0 Amps non-inductive.
 - 5. Temperature blade: shall support 8 analog temperature sensor inputs. Temperature range shall be 32° to 158° F (0° to 70° C). Temperature precision within that range shall be ±1.0° F (±0.5° C).

2.8 HARDWARE PACKAGING REQUIREMENTS

- A. The Access Control system shall have various hardware enclosures and configurations available to support different installation requirements. Enclosures shall be available for wall or rack mounting. The wall-mount enclosures shall have a lock requiring a key, and a cabinet door tamper switch.
- B. It shall be a wall-mount enclosure with dimensions of 7" (178 mm) H x 7" (178 mm) W x 3.5" (89 mm) D.
- C. The solid-state controllers shall be powered by either 100-240V AC at 50-60 Hz, or by 12VDC at 3 amps. Power must come from a separate circuit with an isolated earth ground. If AC power is supplied it must be connected to the internal power supply. If DC power is supplied the internal power supply shall be bypassed. It shall be possible to backup power supplied to the Access Control system with an Uninterruptible Power Supply (UPS). It shall also be possible to place within the wall-mount enclosure an SLA battery backup sufficient for an orderly shutdown in case of external power loss.

2.9 SOFTWARE REQUIREMENTS

- A. Operating System and Application Software:
 - 1. The embedded operating system for the solid-state network controller is the Linux Ubuntu operating system. The operating system kernel is open-source and no operating system training or certification shall be necessary.
 - 2. The Access Control system application software is embedded in the system. The database is an embedded PostgreSQL relational database requiring a small footprint and provides high reliability. The web server is based on an embedded Apache™ web server enabling users to access and operate the system using a standard web browser.
- B. Software Licensing:
 - 1. Software licensing is based upon the number of readers, cameras, and select features for one network controller. Software license upgrades shall be available if system reader and camera capacity must be raised. The user license shall be valid in perpetuity and shall include one year of software updates from the date of shipment from the factory.
 - 2. Licensing is controlled by a Product Key and an Activation Key. The Product Key contains the licensed system features and limits. To upgrade your system license to enable more cameras or more doors you will need a new Product Key. The Activation Key contains the warranty expiration date. The keys are locked to the system license number. The system license number shall be viewable on-screen on the Support: About page.
- C. Software Upgrades:
 - 1. Software upgrades shall be possible from a browser on any network-connected PC, by uploading a software update to the controller. Controllers shall automatically upgrade all connected nodes. No client software installation shall be necessary.
- D. Support Collaboration:

1. It is possible, by the use of a network Support Collaboration Tool, for a technical support specialist to connect to the Access Control system and assist on-site technicians from remote network-connected locations. It shall only be possible for an on-site system administrator or technician to initiate this connection. There shall be no way to initiate this connection from outside the secure network.
- E. Language Support:
1. The Access Control system shall be provided with multiple language support. The ability to switch from one language to another shall be accomplished through the user interface. Translation of the user interface, online help and documentation into other languages shall be available. The languages supported shall include:
 - a. English
 - b. Spanish
- F. Floorplans:
1. The Access Control system shall provide graphic floor plan capability including graphic display of links to other floor plans, alarms, system resources such as portals, IP video cameras, inputs, outputs, and temperature monitoring points.
 2. It shall be possible to create floor plan groups for the purpose of assigning or withholding assignment of these groups to system user permissions known as Custom User Roles. If a floor plan group is assigned to a particular system user then the floor plans in that group shall be viewable by that system user.
- G. Personnel Data
1. The Access Control system maintains person data relating to access control, system user privileges, photo identification, system activity, and contact information.
 2. All person data in the system shall be integrated onto one tabbed page for viewing, editing, and deletion by system users.
 3. A system user holding at least an 'Administer' user role shall be able to create, delete, and modify person records, including access levels.
- H. Data Import and Export:
1. A Data Management Tool shall be provided that supports, via an API, the import and export of personnel data. This tool shall make possible the pre-populating, and ongoing populating, of cardholders into the Access Control system database.
- I. Intrusion Alarm Panels:
1. The Access Control system shall be capable of integrating with existing security systems panels.
 2. Security administrators can use events on a Honeywell panel, such as a zone going into an alarm state, to trigger events in the Access Control system. They can also use events in the Access Control system to control operations on the Honeywell panel, such as the arming or disarming of an area.
 3. Monitors can use the Intrusion Panel widget to view configuration and status information for a Honeywell panel. They can also arm and disarm areas, bypass and reset zones, and activate and deactivate outputs associated with the panel.
- J. API Integration:

1. An application programming interface (API) is provided for the Access Control system. The API shall provide programmatic access to the network-connected components managed by the Access Control system.
2. Communication between the Access Control system and another application takes place through the TCP/IP networking protocol. The API is invoked by POSTing an HTTP message to the web server on the network controller.
3. The Access Control system database includes a table of “people” whose records act as container objects for attributes attached to people in real life. People are mapped to access levels, which specify access privileges—and to access cards, whose credentials are used for access control.
4. Access levels are created in the system using the normal web user interface for the Access Control system. People and credentials may be entered into the system either through the web user interface or through the API.
5. The API supports commands for:
 - a. Adding, modifying, removing, and retrieving data about a person, and retrieving information about one or more people based on various search criteria.
 - b. Adding, modifying, and removing credentials, and retrieving a list of the names of defined card formats.
 - c. Adding, modifying, and deleting access levels, and retrieving a list of the valid access levels in the system.
 - d. Pinging the Access Control system to determine its health, and retrieving the current version of the API from the server.
 - e. Retrieving a history of access activity, either for all users or for a particular access card.
 - f. Adding, modifying, and removing threat levels and threat level groups, and setting the threat level in the system.
 - g. Retrieving a list of portals and associated card readers defined for the Access Control system.
 - h. Adding, modifying, deleting, and retrieving time specifications and time specification groups.
 - i. Adding, modifying, and deleting holidays, and returning a list of holiday keys or a specific holiday.
 - j. Adding, modifying, deleting readers and reader groups, and returning a list of reader group keys or information for a specific reader group.
 - k. Adding, modifying, and deleting portals and portal groups, and retrieving information about a specific portal group.
 - l. Requesting events from the Activity Log that occurred within a specified time period. These events are returned from the API in the CSV Export report format.

2.10 ACCESS PERIPHERAL DEVICE

A. Card Readers.

1. Readers shall be OmniProx OP40 Proximity Card Reader interface. Readers shall be black in color.

B. Credentials

1. Furnish 12 of each, OmniProx OP40 Proximity Card Reader.

C. Door Position Contacts

1. Contacts shall be GRI 184-12WG 1" Recessed Door Contact, recessed mount magnetic contacts. At doors also having Intrusion system coverage, use two-pole contacts, one pole to the Access system and one pole to the Intrusion system.

D. Locking Device Power Supplies

1. All electronic door locks will be powered from power supplies furnished by the access control Honeywell system. Furnish and install Honeywell Power Products PW6K2E2PS power supplies. Supplies shall provide six amperes of 12 or 24vdc power. Include two 7-amp hour batteries for each unit. Furnish supplies in quantity required to operate the door locks in normal use.

E. Door Locking Devices

1. All door locking devices and related hardware are to be furnished by the door hardware supplier, and installed by the General Contractor. Electrical connections shall be by Electrical Contractor. The General and Electrical contractors, and the Access Control system supplier shall coordinate all aspects of the door hardware and Access equipment installation.

2.11 ACCESS CERTIFICATIONS

- A. UL 294 listed
- B. ISO 9000 listed

2.12 WIRE AND CABLE

- A. General: 120 VAC power and grounding conductors shall be minimum #14 AWG. All cable shall be suitable for Class 2 circuit use. Minimum insulation rating shall be 300 volts. Cable shall be rated CL2, CL2R or CL2P as required for the environment. CL2 cable shall not be used for riser circuits. Maintain a consistent color-coding scheme throughout the Project.
 1. Intrusion System DC Power Cable: #16/2 AWG cable non-shielded with over-all jacket.
 2. Intrusion Addressable Loop Cable: #18/4 AWG shielded twisted-pair cable with over-all jacket.
 3. Intrusion Keypad Cable: #18/4 AWG shielded twisted-pair cable with over-all jacket.
 4. Intrusion Motion Sensor Cable: #18/4 AWG shielded twisted-pair cable with over-all jacket.
 5. Intrusion Door Contact Cable: #18/4 AWG shielded cable with over-all jacket.
 6. Intrusion Siren Cable: #16/2 AWG shielded cable with over-all jacket.
 7. Intrusion Multi-pair Telephone Cable: Unshielded #24 AWG twisted-pair unshielded twisted-pair (UTP) cable with over-all jacket. UTP cable shall be 4-pair unless otherwise indicated. Performance shall comply with IIA/EIA Category 3 standards.
 8. Access System DC Power Cable: #14/2 AWG cable non-shielded with over-all jacket.
 9. Access Multi-pair network cable to control panel Cat 6 per specification section 27 15 00.
 10. Access Credential reader cable: #22/6 AWG with overall jacket, containing two unshielded and one shielded pair.
 11. Access lock power cable: #14/2 AWG UTP cable to each door controller for lock power.
 12. Access door position switch cable: #18/2 AWG UTP cable for door position switch connection to door controller.
 13. Access network connection cable: Category 6A; CM, CMR, CMP or OSP as required for the location installed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Submission of a proposal confirms that the Contract Documents and site conditions are accepted without qualifications unless exceptions are specifically noted.
- B. The site shall be visited on a regular basis to appraise ongoing progress of other trades and contracts, make allowances for all ongoing work, and coordinate the requirements of this contract in a timely manner.

3.2 INSTALLATION

- A. The System shall be installed and tested in accordance with the Manufacturer's Installation instructions. The following conditions are applicable:
 - 1. All necessary back-boxes, pull-boxes, connectors, supports, conduit, cable, and wire shall be furnished and installed to provide a complete and reliable System installation.
 - 2. All conduit, cable, and wire shall be installed parallel and square with building lines, including raised floor areas. Conduit fill shall not exceed forty percent (40%). All wires shall be gathered and tied up to create an orderly installation.
 - 3. Install the security intrusion detection system in accordance with the manufacturer's recommendations. Locate equipment and devices as indicated on the drawings.
 - 4. Installation of equipment and devices shall be coordinated with architectural features and the installation of door hardware equipment.
 - 5. Final connections between the equipment and the wiring system shall be made under the supervision of a representative of the system vendor/installer.
 - 6. Select cabinets and back-boxes to fit equipment and devices. Install plumb and aligned with building elements.
 - 7. Wiring shall be arranged as shown on the shop drawings. Outside electrical rooms and telecommunications rooms, wiring and cable shall be installed in raceways or cable trays, except low-voltage cables run above accessible ceilings consisting of removable tiles. Where cable trays are not available above accessible ceilings provide support with hooks or rings listed for use with limited energy wiring. Raceways shall be grounded to the power system ground.
 - 8. Cables shall extend from the control cabinet to the device locations and between devices in uninterrupted continuous runs, without intermediate splices. Cables shall be free from shorts or grounds.
 - 9. Cables shall be routed so as to maintain a separation of at least 24" from all heat sources and from ballasts, transformers, dimmers and other sources of electromagnetic interference. Avoid exposed cables in occupied areas or in areas where they might be damaged as a result of normal use of the area. Where two (2) or more cables run in parallel, they shall be bundled with cable ties.
 - 10. Cables run exposed in ceiling cavities shall be supported by means of suitable cable support devices from the building structure. They shall not lie upon the ceiling, nor shall they be supported from the ceiling frame, ceiling suspension wires, conduits, pipes, ductwork or lights. Supports shall be spaced no further apart than five feet on center.
 - 11. Care shall be exercised during cable installation not to damage cable insulation. Damaged cables shall be removed and replaced. Type and spacing of supports shall ensure that cable will not kink or sag.
 - 12. Cable shall be neatly dressed in the equipment rooms, without excessive slack. Cable path shall offer minimum obstruction to future installation. Avoid cables crossing horizontally through the areas just above or below riser sleeve or cable tray penetrations.

13. In each cable that terminates at an outlet or device, provide 12" of slack cable, neatly coiled, to facilitate future modifications.
 14. Terminations shall be made in a neat and workmanlike manner.
 15. All terminations, controls and outlets shall be clearly and logically labeled in accordance with the requirements in Section 16199.
 16. Personnel Door magnetic contacts shall be flush mounted in doors and door frames.
 17. Motion detectors shall be installed on stainless steel device plates covering flush mounted outlet boxes with manufacturer supplied adjustable ceiling mounts for vertical orientation of the motion sensor.
 18. Keypads shall be surface mounted over flush mounted outlet boxes.
 19. Mount the Intrusion control panel/digital communicator in the location indicated and connect it via a telephone line to a Remote Reporting Agency for security system reporting in accordance with the Owner's direction. The security intrusion detection system shall be connected to transmit alarm and trouble conditions by device and zone with the alarm signals having priority over other signals. The communicator output shall match the Remote Reporting Agency protocol and the available telephone dialing scheme.
 20. Provide RJ31X jacks and wiring to interface the control panel to telephone lines for remote reporting. The RJ31X jacks shall be wired into the phone lines so that the control panel is the first device on the phone line, and off-normal panel conditions disconnect all downstream devices sharing the phone line. Program the control panel communicator using the communication protocol compatible with the UL-listed monitoring agent designated by the Owner.
 21. Complete the connection to the monitoring account for the Owner. The control panel/digital communicator provided under this Contract shall remain the property of the Owner.
 22. No power shall be applied to the intrusion detection equipment until all connections between the equipment and the wiring system have been checked for grounds, shorts, opens or other wiring defects, and approved by a representative of the equipment manufacturer.
 23. Comply with all requirements of Section 27 15 00 "Communications Cabling."
 24. Provide one Category 6A patch panel in each IDF and MDF, or as required for the Honeywell equipment network connections.
 25. Terminate all Category 6A cables for the Honeywell system.
- B. Coordinate the location of the blue light latching alarm push button under the counter, in the knee space of the receptionist's station, with the school district.
- 3.3 RACEWAY
- A. Provide metallic raceways cables installed in wall, above inaccessible ceilings, exposed or where subject to physical damage, or as indicated on the drawings.
 - B. The Contractor shall provide a complete design-build raceway and cabling system.
 - C. Any cable underground of under slab in raceway, shall be properly "wet" rated for the intended use.
- 3.4 DEVICE BOXES
- A. Provide appropriate back box, as suggested by manufacturer, at each card reader location.
 - B. Provide the manufacturer back box for the door controller.

3.5 PROGRAMMING

- A. The intrusion detection system shall be programmed by an authorized manufacturer's representative to function as specified under the description of system operation, including the interface to the digital communicator and zone assignments. Programming shall comply with direction received from the Owner's Representative or Architect.
- B. Program output to the networked lighting control system to automatically turn on the corridor lighting upon badge in.
- C. Program the system to initiate lockdown upon activation of the pushbutton located in the Administration. Divide the system into the areas indicated on the shop drawings. Program each keypad to activate and deactivate each area by entering separate entry codes. Use codes provided by the Owner. Each keypad shall be capable of activating/deactivating each area individually and activating/deactivating all areas simultaneously.
- D. Final system programming shall reflect room numbers/names as selected by the Owner or Architect. Room numbers shown on plans are architectural designs numbers for construction purposes. These numbers shall not be used for programming unless specifically directed by the Owner or Architect.
- E. Program Honeywell relays to interface to portions of the building lighting system. One relay shall function to turn off all interior lighting upon a valid credential presentation to ARM the building at a keypad. Another relay shall function to turn on all interior corridor lighting upon an ALARM condition created by intrusion. Relays shall be able to be turned ON/OFF from a keypad by someone having the proper system authorization attached to their passcode.
- F. Program digital communicator to communicate with the remote reporting agency.
- G. Submit documentation of system programming.

3.6 ADJUSTMENT, TESTING & DEMONSTRATION

- A. Supply tools, instruments, gauges, testing equipment, protective devices and safety equipment for adjustment, testing and demonstration.
- B. During adjustment and testing, carefully record all settings and all test results, including expected test results, actual test results, and corrective actions taken. Records shall be submitted to the Architect's Consultant and included in the Operating and Maintenance Manuals.
- C. Test all system cable after installation and prior to connection to equipment. Tests to be performed shall include, but not be limited to, the following:
 - 1. Conductor continuity.
 - 2. D.C. insulation resistance.
 - 3. Freedom from shorts and grounds.
- D. Make adjustments as necessary to aim motion sensors and set sensitivity levels to provide proper area coverage in accordance with the direction of the Owner's Representative.

- E. Test all system features for proper function. Tests shall be conducted by the manufacturer's authorized vendor/installer. Notify the Remote Reporting Agency prior to beginning tests. Tests to be performed shall include, but not be limited to, the following:
1. Verify that the keypad functions properly to arm and disarm the system.
 2. Verify that the keypad functions properly to acknowledge/deactivate alarms and reset the system.
 3. Verify proper operation of battery backup by performing tests for 60 minutes with the normal AC power source disconnected.
 4. Verify the proper initiation of the trouble signal for disconnection of AC power.
 5. Verify the proper operation and range of coverage for each motion detector by entering the protected space from different directions with the system armed.
 6. Verify the proper initiation of the trouble signal for disconnecting a motion detector.
 7. Verify the proper operation of each door position switch by opening the door with the system armed.
 8. Verify the proper annunciation and display of each alarm and trouble condition.
 9. Furnish documentation that all alarm and trouble conditions were correctly reported to the Remote Reporting Agency.
- F. Correct any deficiencies discovered as a result of the above testing, and completely retest the work affected by such corrections, with no additional compensation.
- G. After the system has been completed, tested and is operating properly, the manufacturer's representative shall test and demonstrate by actual usage, the proper operation of each control device and system function in the presence of the Owner's Representative. Demonstration shall include repetition of selected field tests, as well as additional adjustment or testing required to demonstrate that the system performs in accordance with the operational description as specified herein and the Owner's operational requirements.

3.7 COMMISSIONING

- A. Field tests shall be witnessed by the Commissioning Agent, the Electrical Engineer, or other party so designated in other sections of the project specifications.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
1. Visual Inspection: Conduct visual inspection prior to testing.
 2. Inspection shall be based on completed Record Drawings and system documentation.
 3. Factory-authorized Honeywell representative shall demonstrate the system operation and performance to the Commissioning Agent, or other designated agent.
 4. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

3.8 DEMONSTRATION

- A. Engage a factory-authorized Honeywell system representative to train Owner's maintenance personnel to adjust, operate, and maintain the ACS system.
- B. Engage a factory-authorized Honeywell representative to train the Owner's school staff to operate the ACS system.
- C. Engage a factory-authorized Honeywell representative to train Owner's maintenance personnel to program, adjust, operate, and maintain the ACS system.
- D. Engage a factory-authorized Honeywell representative to train the Owner's school staff to operate the intrusion system.

3.9 ON-SITE TRAINING

- A. Supply one (1) hour minimum of training for the Owner's staff in operating the intrusion detection system. In addition, the Contractor shall supply one (1) hour minimum of further training for the Owner's maintenance personnel regarding maintenance of the system. Training time shall be extended as necessary to satisfy the Owner's Representative that all pertinent topics have been adequately covered.
- B. The training shall be conducted after the Operating and Maintenance Manuals for the Project are completed and available for use during the training session.
- C. Maintain a training sign-in sheet upon which participants in the training session, including the instructions, shall record their names. The training sign-in sheet shall be dated.
- D. Training shall be conducted by the manufacturer's authorized vendor/installer of the equipment manufacturer who is thoroughly familiar with the equipment and its features, and with the Project. The training shall include instruction, field demonstration and over-the-shoulder hands-on training. As a minimum, the training shall cover, but not be limited to, the following topics:
 - 1. System features, including expansion capability.
 - 2. Interpretation of system outputs (indicators, displays, etc.).
 - 3. Arming and disarming the system.
 - 4. Acknowledging/deactivating alarms and resetting the system.
 - 5. Recommended maintenance procedures and intervals.
- E. General overview of access control and intrusion detection systems, including purpose and principle of operation.
- F. At the conclusion of the training session, insert a copy of the training sign-in sheet into the Operating and Maintenance Manuals. Submit another copy of the training sign-in sheet to the Architect.

3.10 AS-BUILT DRAWINGS

- A. Comply with Division 28, Section 28 05 00, "Common Work Results for Electronic Safety and Security Systems."

- B. The contractor shall certify completion of the intrusion and Access Control systems installation and testing in accordance with the plans and specifications. Any original copy of the Record of Completion shall be delivered to the Owner's Representative and photocopies shall be included in the O&M manuals.

3.11 OPERATING DOCUMENTS

- A. The contractor shall furnish to the Owner, operating instructions outlining the step-by-step procedures required for system start-up, operation, and shutdown at least thirty (30) calendar days prior to acceptance test. The instructions shall include the manufacturer's name, system model number, service manual, parts list, and a description of all equipment and their basic operating features.

3.12 WARRANTY

- A. The warranty period shall be as specified in the General Conditions, but not less than one (1) calendar year from the date of project final completion. The intrusion detection system equipment vendor shall warranty the all intrusion detection system equipment to be free from defects in materials and workmanship. The installing Contractor shall warranty all wiring and installation devices to be free from defects in materials and workmanship. The warranty shall cover the full cost of all repairs and all replacement costs for all system components. The equipment vendor and installing contractor shall have the option to repair or replace any system component. This warranty shall not be pro-rated, and there shall be no deductible amount.

END OF SECTION 28 31 13

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