

Notice

Basic Information

Reference Number	0000406793
Issuing Organization	Dallas County
Owner Organization	
Solicitation Type	IFB - Invitation for Bid (Formal)
Solicitation Number	2026-007-7092
Title	George Allen Air Replacement of 3 Air Handler Units and HVAC Coils
Source ID	PU.AG.USA.2438.C21491501
Piggyback Solicitation	No

Details

Location	Dallas County, Texas
Description	This project includes the replacement of steam and chilled water coils in multiple existing air handler units (AHU) and associated duct revisions on level 9 at George Allen Courthouse. Also, the replacement of one air handler unit (AHU) and combining two existing air handler units into one unit located at basement level B1. This project will be a one-time contract award. The County expects all work to be completed within the established timeframe, adhering strictly to the standards outlined in the Construction Documents. During the solicitation process bidders are required to limit their communication regarding this project to the Buyer referenced herein. A pre-bid meeting will be held by the County whereby the bidders will have an opportunity to ask the requesting department(s) questions and/or obtain clarification. The pre-bid meeting will be the only time when bidder and requesting department(s) will communicate directly, thereafter, all communication associated with this project shall be address through the County's purchasing platform, (https://www.bidnetdirect.com/texas/dallas-county), to the assigned Buyer. The County will respond to all questions by way of addendum which will be posted as part of the solicitation. The County, its agents, and employees shall not be responsible for any information given by way of verbal communication. Pre-bid conference December 18, 2025 at 10:30 a.m. (CST), the pre-bid meeting will be conducted through a conference call.

Dates

Publication	12/11/2025 03:58 PM CST
Question Acceptance Deadline	12/18/2025 04:00 PM CST
Questions are submitted online	Yes
Closing Date	01/29/2026 02:00 PM CST

Onsite Visit	12/18/2025 01:00 PM CST

Contact Information

Kelli Wright
214-653-7434
kelli.wright@dallascounty.org

Buyer Preferences, Guidelines & Requirements

General Requirements

- Bid Deposit Required

Bonding Requirements

- Bid Bond	5.00 %

Pre-Bidding Events

Event Type	Onsite Visit
Attendance	Recommended
Event date	12/18/2025 01:00 PM CST
Location	600 Commerce Street Dallas, Texas 75202
Event Note	Meet in the main lobby off of Commerce Street, outside of security perimeter.

Bid Submission Process

Electronic or Physical Bid Submission

Lump sum

Lump sum

Bid Documents List

Item Name	Description	Mandatory	Limited to 1 file
SBE forms	Attachment S - Small Business Enterprise (SBE) Forms must be submitted with bid	Yes	No
W-9	W-9 form signed in 2026	Yes	No
Bid Security or Bid Bond	Bid Security or Bid Bond	Yes	No

Documents & Items

Documents

Document	Size	Uploaded Date	Language
DALLAS COUNTY STANDARD TERMS AND CONDITIONS IFB (1).pdf [pdf]	342 Kb	12/20/2024 02:00 PM CST	English
SBE_Language_for_IFB_2.24.24_ATTACHMENT_S.pdf [pdf]	536 Kb	12/19/2024 11:15 AM CST	English
2026-007-7092 IFB George Allen Air Replacement of 3 Air Handler Units and HVAC Coils.pdf [pdf]	216 Kb	12/11/2025 09:28 AM CST	English
Exhibit A - Dallas County HVAC - Issue for Bid - Project Manual.pdf [pdf]	9 Mb	12/11/2025 09:28 AM CST	English
Exhibit B - Issue for Bid Set.pdf [pdf]	6 Mb	12/11/2025 09:28 AM CST	English
SBE Vendor List [pdf]	146 Kb	12/11/2025 09:29 AM CST	English

Items

No	Description	UOM	Qty
1	Lump sum for total project amount Brand Preference: Not Applicable - Service Item	Lump-Sum	1

Categories

Selected Categories

NIGP Categories (6)	
941	EQUIPMENT MAINT, REPAIR, AND RELATED SERVICES FOR POWER GENERATION AND TRANSMISSION EQUIP.
94155	HVAC Systems Maintenance and Repair, Power Plant HVAC Systems Maintenance and Repair, Power Plant
992	TESTING AND CALIBRATION SERVICES
99247	HVAC System Testing, Balancing and/or Troubleshooting Services HVAC System Testing, Balancing and/or Troubleshooting Services
914	CONSTRUCTION SERVICES, TRADE (NEW CONSTRUCTION)
91450	Heating, Ventilating and Air Conditioning (HVAC) Heating, Ventilating and Air Conditioning (HVAC)
967	PRODUCTION AND MANUFACTURING SERVICES
96702	Air Conditioning, Heating, and Ventilating Equipment (HVAC) Manufacturing Services Air Conditioning, Heating, and Ventilating Equipment (HVAC) Manufacturing Services
031	AIR CONDITIONING, HEATING, AND VENTILATING EQUIPMENT, PARTS AND ACCESSORIES (SEE CLASS 740 ALSO)
03100	AIR CONDITIONING, HEATING, AND VENTILATING EQUIPMENT, PARTS AND ACCESSORIES (SEE CLASS 740 ALSO)
910	BUILDING MAINTENANCE, INSTALLATION AND REPAIR SERVICES
91017	Energy Computerized Control System (HVAC, Lighting, Utilities, etc) Installation, Maintenance and Repair Services Energy Computerized Control System (HVAC, Lighting, Utilities, etc) Installation, Maintenance and Repair Services

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DALLAS COUNTY STANDARD TERMS AND CONDITIONS

By returning the Bid Proposal with a price quote, vendors certify and agree that:

1. All charges – wages, salaries, taxes including payroll taxes, benefits, insurance, overhead, fees, permits, licenses, fees, labor, personnel, service, supervision, documentation, administration, training, implementation, materials, supplies, delivery, transportation, shipping , freight, fuel surcharges, mileages, parking, tolls, travel time, and all other associated cost direct and indirect including incidentals necessary to provide the goods and services outlined in this solicitation specified or implied are to be included in bid proposal cost. Services and Inside Delivery will be F.O.B.: Dallas County as indicated on each individual purchase order.

2. **TEXAS GOVERNMENT CODE CHAPTER 2271 VERIFICATION – BOYCOTT ISRAEL**

Effective September 1, 2017, the State of Texas requires all governmental entity, state agency or political subdivision (which includes counties) to obtain written verification from the Company that their Company does NOT boycott Israel and will not boycott Israel during the life of this contract, agreement or purchase order (hereafter referred to as "Contract"). By accepting this Contract, the Company (Professional or other applicable term defining the contracting party) verifies that it does not Boycott Israel, and agrees that during the term of this Contract will not Boycott Israel as that term is defined in Texas Government Code Section 808.001, as amended." The County cannot execute a contract for goods and services without this declaration. Please refer to Texas Government Code, Subtitle F, Title 10, Government Code Chapter 2270.

(a) This section applies only to a contract that:

- (1) is between a governmental entity and a company with 10 or more full-time employees; and*
- (2) has a value of \$100,000 or more that is to be paid wholly or partly from public funds of the governmental entity.*

3. **CONFLICT OF INTEREST QUESTIONNAIRE (CIQ) FORM**

Effective January 1, 2006, Chapter 176 of the Texas Local Government Code requires that any vendor or person considering doing business with a local government entity disclose in the Questionnaire Form CIQ, the vendor or person's affiliation or business relationship that might cause a conflict of interest with a local government entity. By law, this questionnaire must be filed with the records administrator of Dallas County no later than the 7th business day after the date the person becomes aware of facts that require the statement to be filed. See Section 176.006, Local Government Code. A person commits an offense if the person violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor. By submitting a response to this request, the vendor represents that it is in compliance with the requirements of Chapter 176 of the Texas Local Government Code. Contractor shall complete and file the Conflict of Interest Questionnaire with the Dallas County Clerk at 1201 Elm Street, 21st Floor, Dallas, Texas 75270.

4. **CERTIFICATE OF INTERESTED PARTIES FORM 1295**

In 2015, the Texas Legislature adopted House Bill 1295, which added section 2252.908 of the Government Code. The law states that a governmental entity or state agency may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties form to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental entity or state agency. The form discloses any interested parties who have a controlling interest (10% or more ownership) in the business entity and those who actively participate in facilitating the contract or negotiate the terms of the contract (broker, intermediary, advisor, and/or attorney), if any. The disclosure requirement applies to a contract entered into on or after January 1, 2016.

The Texas Ethics Commission was required to adopt rules necessary to implement that law, prescribe the disclosure of interested parties form, and post a copy of the form on the commission's website. The commission adopted the Certificate of Interested Parties form (Form 1295) on October 5, 2015 and new rules (Chapter 46) on November 30, 2015.

The "Certificate of Interested Parties" form must be completed on the Texas Ethics Commission website, printed, signed, and submitted to the County by the authorized agent of the Business Entity with acknowledgment that disclosure is made under oath and under penalty of perjury prior to final contract execution.

To obtain additional information on HB 1295, to learn more about Texas Ethics Commission process to create a new account or to complete an electronic version of Form 1295 for submission with a signed contract, please go to the following website: <https://www.ethics.state.tx.us/tec/1295-Info.htm>

Instructional Videos for Business Entities on how to file online can be found at https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm

The identification number (section 3 of the form) to be used on the 1295 for this procurement is the IFB solicitation number.

5. **TITLE VI ASSURANCES/COMPLIANCE POLICY**

The County, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

Pursuant to Title VI requirements, any entity or person that enters into a contract with Dallas County including, but not limited to prime contractors, sub-contractors, and sub-recipients, may not discriminate on the basis of race, color, national origin, age, sex, disability, or religion in their selection and retention of subcontractors (including consultants), in connection with any federally funded program or activity (including any program or activity undertaken/funded by a Dallas County Division/Department that receives federal funds).

6. **TEXAS GOVERNMENT CODE CHAPTER 2252 ATTESTATION**

By entering into this Contract, Contractor attests that Contractor is not a company that is identified on a list prepared and maintained by the Texas State Comptroller under Section 2252.153, Tex. Gov't Code, as a company known to have contracts with or provide supplies or services to a foreign terrorist organization as designated by the U.S. Secretary of State.

7. **PRE-AWARD SURVEY**

After bid opening and before award, County may perform a pre-award survey of the bidder's facilities and equipment to be used in the performance of work under this solicitation. Bidder agrees to allow all reasonable requests for inspection of his or her facilities.

8. After bid opening and before award Dallas County reserves the right to request the bidder to provide, but not necessarily limited to, the following forms:

- a. Texas Government Code Chapter 2270 Verification Form
- b. Texas Government Code Chapter 2252 Certification Form
- c. 1295 Form
- d. W-9 Form

9. The bid award shall be based on, but not necessarily limited to, the following factors:

- e. Unit Price
- f. Total Bid Price
- g. Delivery Date
- h. Results of Testing Samples
- i. Special Needs and Requirements of Dallas County
- j. Dallas County's Experience with Products Bid
- k. Vendor's Past Performance Record with Dallas County
- l. Dallas County's Evaluation of Vendor's Ability
- m. Estimated Costs for Supplies, Maintenance, etc.
- n. Estimated Surplus Value
- o. Small Business Enterprise completed forms
- p. Dallas County reserves the right to award to a primary and secondary vendor(s).

Dallas County shall award this contract to the responsive bidder(s) offering the lowest and best bid in accordance to Local Government Code 262.021(5-a) who comply with all of the requirements, terms and conditions prescribed herein. Dallas County reserves the right to reject any or all bids in whole or in part, to make multiple awards, partial awards, award by item by item basis, award by types, award by sections, or lump sum total, and waive any immaterial deviations in the bid as may be considered in the best interest of the County.

10. **INVOICING/BILLING**

Invoices will be submitted to the Dallas County Auditor's Office. All billings must have appropriate supporting documentation before such billings will be approved. Billing shall cover goods and services not previously invoiced. Vendor shall reimburse the Dallas County for any monies paid to Contractor for goods or services not provided or when goods/services provided do

not meet the contract agreement or solicitation requirements. Payments made by the County shall not preclude the right of the County from thereafter disputing any items involved or billed under the contract agreement or solicitation and shall not be construed as acceptance of any part of the goods or services. Contractor understands and agrees that any funds paid under this contract are contingent upon satisfactory delivery of the Services as described in this contract and subject to routine processing. No payment, on any basis, will be made for unsatisfactory work.

Contractor agrees to submit complete, fully documented and accurate itemized statement of invoices with appropriate/applicable attachments and documentation, as required by the County for all goods, services, and work performed **following acceptance of goods, services or work by the County.**

At minimum, the original invoices submitted against the IFB, must reference all of the following information:

- a. Contractor/Vendor Name
- b. Contractor/Vendor Address
- c. Contractor/Vendor Contact Information
- d. Contractor/Vendor Telephone Number and Fax Number
- e. Contractor/Vendor Remittance to Address
- f. Invoice Date
- g. Invoice Number (uniquely numbered, no duplicates)
- h. Valid Dallas County Purchase Order Number must appear on all itemized invoices and packing slips
- i. Solicitation Number
- j. Date of Services or Date Purchase
- k. Description of Services and Goods
- l. Cost of Services and Goods

Invoices and support documentation are to be sent to:

Original Invoice: Dallas County Auditor's Office
Attn: Accounts Payable
500 Elm Street, Suite 4200
Dallas, TX 75202
214.653.6478
Accounts.Payable@dallascounty.org

Copy of invoice(s) shall be sent to: REQUESTING USER DEPARTMENT NAME AND ADDRESS INDICATED ON THE PURCHASE ORDER

All invoices must reference a Dallas County Purchase Order Number

Payment will be made upon receipt and acceptance by the County of completed services, goods and/or products ordered and receipt of a valid invoice, in accordance with the Texas Government

Code, Chapter 2251. The County will incur no penalty for late payment if payment is made within thirty (30) or fewer days from the statement if there is an uncontested billing. Any payment not made within thirty (30) days of its due date shall bear interest in accordance with Chapter 2251 of the Texas Government Code. Invoices received without all the required supporting documentation and information will not be processed and will be returned to the Contractor unpaid for correction.

11. If applicable, a packing list or other suitable shipping documents shall accompany each shipment and shall show:
 - (a) Name and address of vendor
 - (b) Name and address of receiving department
 - (c) Dallas County Purchase Order number and
 - (d) Description of material shipped, including item numbers, quantity, number of containers, and package number, if any.

12. **ACH ELECTRONIC PAYMENTS**

ACH Electronic Payments

Dallas County offers ACH vendor and supplier payment services for all vendors and suppliers providing goods, services or products to Dallas County.

Dallas County is moving away from making payments by paper checks and we are strongly encouraging vendors and suppliers to accept electronic payments. Below is the option that is currently available in lieu of a paper check. Dallas County has chosen the Paymode-X ACH payment service through Bank of America for this efficient form of payment.

There is no cost or fee to the vendor or supplier of any kind resulting from the acceptance of an ACH payment from Dallas County via PaymodeX. This allows Dallas County to directly deposit invoice payments into the vendor's bank account along with complete remittance information that can be accessed at any time.

For more information regarding Paymode-X, please visit our website at: <http://portal.paymode.com/dallascounty/> or call customer service @ 877.443.6944 or contract the Dallas County Auditor's Office – Account Payable Division at 214.653.6473.

13. Upon request by Dallas County, bidders agree to furnish samples and/or demonstrations of products bid, as applicable. The product(s) requested will be furnished at no additional cost to Dallas County and will be of sufficient amounts and/or time frames agreed by County and bidder to ensure effective testing of the products(s). Any testing product used beyond the agreed upon amount or time frame may be considered for payment by Dallas County, if in the best interest of the County. Any product that fails testing shall be considered sufficient reason to reject the bid or product. Any product used by Dallas County, during the contract period that does not perform as specified and/or approved during testing shall be considered grounds for cancellation of the contract.
14. Whenever an article or material is defined by describing a proprietary product or by using the name of a manufacturer, the term "or equal" if not inserted shall be implied. The specified article or material shall be understood as descriptive and not restrictive. As determined by Dallas County, equal is considered as articles or materials which can effectively and economically

perform the required task; is comparative in quality and performance and, if required, is acceptably similar or matches the specified structural design.

If the amount shown in words and its equivalent in figures do not agree, the written words shall be binding. Ditto marks are not considered writing or printing and shall not be used.

15. The Contractor shall be considered an Independent Contractor and not an agent, servant, employee, or representative of the County in the performance of the work. No term or provision hereof or act of the Contractor shall be construed as changing that status.
16. The Contractor agrees that it will protect, defend, indemnify, and save whole and harmless the County and all of its officers, agents, and employees from and against all claims, demands, causes or action, damages, judgments, loss and expenses, including attorney's fees, of whatsoever nature, character, or description that any person or entity has or may have arising from or on account of any injuries or damages (including but not restricted to death) received or sustained by any person, persons, or property, on account of, arising out of, or in connection with the performance of the work, including without limiting the generality of the foregoing, any negligent act or omission of the Contractor or any agent, servant, employee or sub-contractor of the Contractor in the execution or performance of this Contract. Contractor further agrees to protect, indemnify and hold County harmless against and from any and all claims and against and from any and all loss, cost, damage, judgments or expense, including attorney's fees arising out the breach of any of the requirements and provisions of this contract of any failure of Contractor, its employees, officers, agents, contractors, invitees, or assigns in any respect to comply with and perform all the requirements and provisions hereof.
17. The Contractor agrees, during the performance of the work, to comply with all applicable codes and ordinances of the appropriate City, County or the State of Texas as they may apply, as these laws may now read or as they may hereafter be changed or amended.
18. The Contractor shall obtain from the appropriate City, Dallas County or the State of Texas the necessary permit(s), if any, required by the ordinances of the City, County or State for the performance of the Work.
19. The Contractor shall not sell, assign, transfer or convey this Contract, in whole or in part, without the prior written consent of the County.
20. Should Dallas County authorize the original awardee to subcontract (assign) any portion of this contract, the original awardee will maintain the ultimate legal responsibility for all services according to contract specifications. In the event of a subcontract, the original awardee must maintain a continuous effective business relationship with the subcontractor(s) including, but not limited to, regular payments of all monies owed to any subcontractor. Failure to comply with these requirements, in whole or part, will result in termination of this contract and/or legal ramifications, due to nonperformance.

Should Dallas County authorize the original contractor to transfer this contract, in whole or part, the secondary contractor will maintain all the legal responsibilities set forth in the context of this contract.

21. In case any one or more of the provisions contained in this Contract shall for any reason be held to be invalid, illegal, or unenforceable in any respect, such invalidity, illegality, or unenforceability shall not affect any other provision thereof and this Contract shall be considered

as if such invalid, illegal, or unenforceable provision had never been contained herein.

22. The parties herein agree that this Contract shall be enforceable in Dallas County, Texas, and if legal action is necessary to enforce it, exclusive venue shall lie in Dallas County, Texas.

23. This Contract shall be governed by and construed in accordance with the laws of the State of Texas and all applicable Federal Laws.

24. **Scanned or Re-typed Response:**

If in its response, bidder/offeror either electronically scans, re-types, or in some way reproduces the County's published bid or proposal specifications, then in the event of any conflict between the terms and provisions of the County's published bid or proposal specifications, or any portion thereof, and the terms and provisions of the response made by bidder/offeror, the County's bid or proposal specifications as published shall control.

Furthermore, if an alteration of any kind to the County's published bid or proposal specifications is only discovered after the contract is executed and is or is not being performed; the contract is subject to immediate cancellation.

25. This Contract embodies the complete agreement of the parties hereto, superseding all oral or written previous and contemporary agreements between the parties and relating to matters herein, and except as otherwise provided herein cannot be modified without written agreement of the parties.

26. Multi-year service/lease-purchase agreements or any continuing contracts are solicited and awarded based on governmental fiscal funding. If for any reason, funds are not appropriated to continue the service/lease- purchase agreement, the said agreement/contract shall be automatically terminated on the expiration date or date in which the funds have been eliminated. Any/all services/leased equipment will be removed from the respective county department/facilities without penalty to Dallas County. Any/all charges incurred as a result of this action are the responsibility of the contractor.

27. Contractors are not officially authorized to begin work and/or deliver items covered under this agreement until formal approval and/or a signed contract is executed by the proper county authorities. Dallas County accepts no liability, of any kind, for products/services delivered/furnished without proper authorization.

28. Except for proposals received under Local Government Code 262.030 and/or 262.0295, in accordance with the aforementioned statutes, Dallas County will uphold the confidentiality of bidder trade secrets to the extent allotted by law. All confidential information must be clearly identified and separated, by the bidder and prior to submission of the proposal.

29. **OPEN RECORDS**

All responses submitted to Dallas County become the property of Dallas County and are subject to the Public Information Act (Texas Government Code Chapter 552). The interested

firms/individuals should familiarize themselves with the provisions of that Act. In no event shall Dallas County, or any of its agents, representatives, consultants, directors, officers, or employees, be liable to a firm/individual for the disclosure of all or any portion of a response submitted pursuant to the IFB.

If a firm/individual has special concerns about information that it desires to make available to Dallas County, but which it believes constitutes a trade secret, proprietary information or other information excepted from disclosure, such firm/individual should specifically and conspicuously designate ((i.e. mark confidential) each page of that information, which the Bidder believes, should not be disclosed outside Dallas County. Disclosure of requested information will be subject to the Texas Public Information Act.

30. **TERMINATION**

The County may, at its option and without prejudice to any other remedy to which it may be entitled at law or in equity, or elsewhere under this contract, terminate this Contract, in whole or part, by giving 10 days advance written notice thereof to the Contract with the understanding that all (products/services) being (delivered/performed) under this Contract shall cease upon the date specified in such notice. The County shall compensate the Contractor in accordance with the terms of this contract for the (products/services) (delivered/performed) prior to the date specified in such notice.

31. **TERMINATION FOR DEFAULT OR NON-PERFORMANCE**

Default, material breach, or non-performance of the bidder in terms of specifications or non-compliance with the terms of this contract shall be a basis for termination of the contract by the County. Termination in whole or in part, by the County may be made at its option and without prejudice to any other remedy to which it may be entitled at law or in equity, or elsewhere under this Contract, by giving ten (10) days' advance written notice setting forth the nature of the material failure or non-performance to the Contractor and/or bidder with the understanding that all work being performed under this contract shall cease upon the date specified in such notice. The termination will not be effective if the material failure is fully cured prior to the end of the stated in written notice NOT LESS THAN TEN (10) day period.

Termination under this will not relieve Contractor from liability for any default or breach under this contract agreement or any other act or omission of Contractor.

The County shall not pay for work, equipment, services or supplies which are unsatisfactory. Contractor may be given a reasonable opportunity prior to termination to correct any deficiency. This however shall in no way be construed as negating the basis for termination for non-performance. In addition and as authorized by Commissioners Court, vendors terminated for non-performance will be disbarred from award consideration on future county solicitation for a period of not less than thirteen (13) months.

32. **MONETARY RESTITUTION**

In the event the contract is prematurely terminated due to default, non-performance and/or withdrawal by the contractor, Dallas County reserves the right to seek monetary restitution (to include but not limited to; withholding of monies owed) from the contractor to cover costs for interim services and/or to cover the difference of a higher cost (difference between termination vendor's rate and new company's rate) beginning the date of vendor's termination through the contract expiration date. In the event a civil suit is filed to enforce this provision, Dallas County will seek its attorney's fees and cost of suit from the Contractor.

33. **NON-EXCLUSIVITY**

This contract and/or agreement is non-exclusive and shall not in any way preclude Dallas County from entering into similar agreements and/or arrangements with other Vendors, Contractors, or from acquiring similar, equal or like goods and/or services from other entities or sources including state contracts.

34. **NEPOTISM**

No person (1) who is an employee, agent, consultant, officer, or official of the contractor and who exercises or has exercised any functions or responsibilities with respect to assisted contract activities; or (2) who is in a position to participate in a decision-making process or gains inside information with regard to such activities, may obtain a personal or financial interest or benefit, direct or indirect, in any contract, subcontract, or agreement with respect thereto, or the proceeds thereunder, either for themselves or those with whom they have family or business ties, during their tenure.

35. **RIGHT TO PROTEST**

Vendors aggrieved in connection with a specific solicitation, evaluation, or the award of any bid, purchase order, or contract, may formally protest to the Purchasing Director only if the Vendor has reason to believe that, with respect to a specific solicitation, (a) there was a material violation of state or federal statutory requirements, County Purchasing Department rules and regulations, or this Code of Ethics (including the Restricted Contact Period), or (b) the procurement process gave an unfair advantage or unfair disadvantage to one or more Vendors.

Procurement processes that may give an unfair advantage or disadvantage to one or more Vendors include, but are not limited to, the following:

- i. The specification unfairly limits competition for no legitimate purpose;
- ii. The contract award is compromised by improprieties in post-award negotiations;
- iii. The evaluation factors or criteria are applied in a manner that is different than disclosed in

the solicitation; and

iv. There are irregularities in the receipt or opening of solicitation responses.

Protests must be in written form and must contain the following information (if applicable):

i. The protesting Vendor's name, address, telephone number, fax number, and email address;

ii. The identifying number of the solicitation and/or contract;

iii. The date the Vendor became aware of the facts forming the basis of the protest;

iv. A detailed statement of the factual grounds for the protest, including copies of any relevant documents or evidence and the statute, rule, or regulation that was violated, if applicable; and

v. A sworn certification that the protest is brought in good faith and for good cause. If a protest is based on an ambiguity or a problem in a solicitation, and is made after the solicitation response deadline, it must also include a certification that the protesting Vendor was not aware of the ambiguity or problem (and did not have an opportunity to ask for clarification or a correction) before the solicitation response deadline.

Protests must timely raise all claims and describe the evidence supporting those claims with specificity. Any claims that are not timely raised may be deemed waived. In the event of a protest during a solicitation response period, a protesting Vendor who wishes to continue in the solicitation process during such protest must still submit a bid or proposal according to the rules set forth in the solicitation.

Protests, including any protest appeals requests, must be sent by mail or email to the Dallas County Purchasing Director at Founders Square, 900 Jackson St., 6th Floor, Suite 680 Dallas, Texas 75202 or Michael.Frosch@dallascounty.org. Mail-in requests must be postmarked and email requests must be received by the Purchasing Director no later than (a) five (5) business days after the date that the protesting Vendor knew or should have known of the facts giving rise to the protest, or (b) before the contract is awarded, if the Vendor is aware of the facts giving rise to the protest prior to the contract award, whichever is earlier.

It is the responsibility of the Vendor to ensure that solicitation protests are delivered to the Purchasing Director within the time period stated herein. Protests that are late or delivered to an incorrect address or individual, or that otherwise do not comply with these rules (including providing the sworn certification as described above), will be declared invalid.

Written Decision. All protests will be initially reviewed by the Purchasing Director, who must rule on the protest and provide a written decision, including the reasons for the decision and the decision date, to the protesting Vendor within ten (10) business days (the “Written Decision”). Any appeal of the Written Decision must be made within five (5) business days of the receipt thereof.

Appeals Process. Appeals of the Written Decision should be sent to the Purchasing Director at the address above, who shall notify the Appeals Committee, consisting of the County Administrator, the County Auditor, and the County Budget Director. The Purchasing Director shall serve as staff to the Appeals Committee and will be present at the Appeals Hearing. The protesting Vendor shall be notified of the time and place of the Appeals Hearing and will be provided an opportunity to present arguments. The documentary evidence at the Appeals Hearing is limited to the documentary evidence submitted for the original protest unless, for good cause shown, the Appeals Committee grants authority for the protesting Vendor to provide additional documentary evidence. The protesting Vendor shall seek approval to submit additional documentary evidence for good cause as soon as possible, but no later than (a) five (5) days before the hearing, or (b) within seventy-two (72) hours from when the protesting Vendor knew or should have known about the additional evidence, whichever period is shorter. The request should include copies of the additional documents that the protesting Vendor seeks authority to use at the hearing. The Appeals Committee may appoint an independent hearing examiner to conduct the hearing and provide a written recommendation, if needed. A written final decision, including the reasons for the final decision and the decision date, will be provided to the protesting Vendor within ten (10) business days of the Appeals Hearing (the “Final Decision”). Requests for an appeal of the Final Decision must be mailed or emailed to the Purchasing Director within five (5) business days of the Final Decision, who will notify the Commissioners Court of the request.

A Commissioners’ Hearing may take place at the discretion of the Commissioners Court. A single vote of a Commissioner on the Commissioners Court is required for a Hearing to be granted. The Commissioners may, at any time during the process, review the written record of the previous decisions on the matter. All decisions of the Commissioners Court, including whether to allow a Commissioners’ Hearing, are final.

Right to Appear before the Commissioners Court. All individuals and entities have the right to an appearance before the Commissioners Court subject to the rules of the Court, this Code of Ethics, and, during an Active Solicitation, the Restricted Contact Period provisions in Section 6 herein. However, a protesting Vendor does not have an automatic right to a Commissioners’ Hearing on any protest appeal under this Code of Ethics, which will be granted only at the discretion of the Commissioners Court.

Notification. Protest hearings are open to the public. Public notification of any hearings, including Appeals Hearings and Commissioners’ Hearings, shall be posted on the Dallas County Purchasing website at www.dallascounty.org/departments/purchasing

Solicitations and Contracts Pending. Filing a protest under this Section will not trigger an automatic stay of any procurement process or contract award. It is in the discretion of the Purchasing Director and the Commissioners Court whether to stay any procurement process or contract award with respect to any Vendor protest. Whether a stay is granted shall not compromise any protesting Vendor’s right to the protest procedures outlined herein.

Records. Records of all protests, including the protest filed, related evidence, and any Written and Final Decisions (including the outcome of any Commissioners' Hearing, if applicable) will be maintained by the Purchasing Department for a period of no less than four (4) years.

36. Contractors are required to comply with the Equal Employment Opportunity Act requiring that no person shall be discriminated against on the basis of race, color, religion, sex or national origin in all phases of employment during the performance of this Contract. The successful bidder shall take affirmative action to ensure that applicants are employed and treated during employment, without regard to their race, age, color, religion, sex or national origin. This action shall include, but not be limited to, employment, upgrading, demotion, transfer, recruitment, advertising, layoff, termination, compensation and selection for training. The successful bidder shall state to all employees and advertisements that all employees and qualified applicants will receive consideration for employment without regard to race, color, age, religion, sex, or natural origin.
37. No official or employee shall have any financial interest, direct or indirect, in any contract with the County or be financially interested, directly or indirectly, in the sale to the County of any land, materials, supplies or services, except on behalf of the County as an official or employee. Any violation of this section, with knowledge, express or implied, of the person or corporation contracting with the County shall render the contract involved voidable by the Commissioners Court of Dallas County. It is the responsibility of the contractor during all phases of the contract process to notify the County in writing of any potential conflict of interest.
38. In the best interest of the County, as determined by the Dallas County Commissioners Court, any bidder/proposer who is currently involved, either directly or indirectly, with any litigation against or involving Dallas County may be disqualified and/or not considered for an award.
39. Pursuant to Sec. 9.001 of the Texas Business Organization Code, non-Texas entities, including, but not limited to corporations, limited partnerships, and limited liability companies must have an application for registration filed with the Texas Secretary of State and shall provide to Dallas County a Certificate of Status issued by the Texas Secretary of State that serves as official evidence of the entity's existence or authority to transact business in Texas. To transact business with Dallas County, all entities must be in legal compliance pursuant to applicable laws, and shall provide to Dallas County evidence of said compliance.
40. Vendor hereby assigns to purchaser any and all claims for overcharges associated with this contract which arise under the antitrust laws of the United States, 15 USCA Section 1 et seq., and which arise under the antitrust laws of the State of Texas, Tex. Bus. & Com. Code, Section 15.01, et seq.
41. Where applicable, MSDS Forms must be provided with delivered products. In addition WITHOUT EXCEPTION, within 30 days after award, the successful bidder(s) MUST furnish Material Safety Data Sheets for all applicable awarded contract items to: Erin Spargo, Ph.D., Southwestern Institute of Forensic Sciences/Office of the Medical Examiner Facility, 2355 Stemmons Freeway, Dallas, Texas 75207. Dallas County reserves the right to withhold payments owed and/or terminate the contract due to non-performance if the aforementioned documents are not provided accordingly.

42. **INTERLOCAL AGREEMENT (City/State Participation Program)**

In accordance with Article 791.025 of the Texas Government Code, governmental agencies (local, state) may request to utilize County contract by executing an interlocal agreement with Dallas County to do so. Vendors are to indicate on the bid proposal page whether they are willing to extend pricing from this contract to other governmental agencies in accordance with the outlined specifications. Dallas County is indemnified against any and all claims that may arise from Interlocal Agreements entered into by the Contractor and governmental agencies.

43. **FEDERAL DEBARRED VENDORS**

No products and/or services utilizing Federal funds may be procured from vendors that are listed on the Federal Excluded Parties List aka System for Award Management (SAM). Government requirements for non-procurement suspension and debarment are contained in the OBM guidance 2CFR, part 180 that implements Executive Orders 12549 and 12689 Debarment and Suspension. Dallas County reserves the right to reject from award consideration and/or terminate any contract with any vendor found to be suspended, ineligible and/or debarred as outlined herein.

44. **TWELVE (12) MONTH WAITING PERIOD FOR EMPLOYMENT OF CERTAIN FORMER COUNTY EMPLOYEES**

In accordance with the County's Transparency Policy, any firm awarded a contract for the Procurement of goods or services shall be prohibited from hiring any individual who has previously worked for the County and in that capacity either evaluated, recommended, approved, monitored, or managed a contract involving that firm no sooner than twelve months after that individual has ceased to work for or be employed by the County. Failure to adhere to such a contractual requirement may result in the termination of the contract with the County.

IFB

ATTACHMENT S
SBE PROGRAM AND FORMS



SBE LANGUAGE

7.0 SMALL BUSINESS ENTERPRISE (SBE) PROGRAM

7.1. Definitions.

- 7.1.1. The term **"Commercially Useful Function"** is defined as a business that is directly responsible for providing the supplies or services to Dallas County as required by the solicitation or request quotes, bids or proposals. A firm is considered to perform a commercially useful function when responsible for the execution of a distinct element of the work of a contract and carries out its responsibilities by actually performing, managing and supervising the work involved. Example: a business that stocks sufficient quantities of supplies in direct inventory which is being held for sale or resale, to cover anticipated future demands for the suppliers is considered to be performing a commercially useful function.
- 7.1.2. A **"Contractor"** is defined as one who participates, through a contract or any other contractual agreement in a County funded contract opportunity for work, labor, services, supplies, equipment, materials, goods or any combination of the aforementioned. For purposes of this Section, a Contractor is any individual, company, or other entity seeking to do work for Dallas County regardless of the method used to procure the services or products, including but not limited to bid or solicitation. A Contractor includes but is not limited to a contractor, consultant, or vendor.
- 7.1.3. The term **"Director of Small Business Enterprise"** shall mean the Director of the County's Office of Small Business Enterprise and/or her/his designee.
- 7.1.4. The term **"Contract Administration"** shall mean the County Purchasing Department and/or his or her designee.
- 7.1.5. The **"Contract Administration Supervisor"** shall mean the Purchasing Director and/or his or her designee.
- 7.1.6. **Equal Employment Opportunity Requirements.** It is the policy of Dallas County to ensure non-discrimination in the award and administration of contracts. The Contractor or Subcontractor shall not discriminate on the basis of race, color, national origin, disability, veteran status, religion, or sex in the performance of any Dallas County contract.
- 7.1.7. **Good Faith Effort Plan.** The plan submitted with a Submittal detailing the Respondent's efforts to achieve the set aspirational goal or documenting the Good Faith Efforts to meet the goals for all elements the Solicitation. A Good Faith Effort Plan must be submitted with a Submittal for any Dallas County projects in which goals have been established.
- 7.1.8. **Metropolitan Statistical Area (MSA).** The Dallas County MSA includes the following counties: Dallas, Tarrant, Denton and Collin.
- 7.1.9. **Small Business Enterprise.** It is the policy of Dallas County to support the growth and development of Small Business Enterprise ("SBE") and ensure that SBEs have an equal opportunity to compete for and participate in Dallas County contracts. Thus, Dallas County Commissioners Court has created the

Office of Small Business Enterprise to establish and oversee a Diversity Program to ensure that SBEs have an equal opportunity to compete for and participate in Dallas County contracts. It is Dallas County's intent to:

- Ensure nondiscrimination in the award and administration of Dallas County contracts;
- Create a level playingfield on which small businesses can compete fairly for Dallas County contracts; and
- Ensure that only firms who attempt in good faith to meet the SBE good faith efforts are considered for applicable contract awards.

Consequently, the contractor shall carry out applicable requirements of the good faith effort in its proposal/bid hereunder and, if awarded the contract, the award and administration of the Contract.

7.2 SBE Goals, Good Faith Efforts and Eligibility.

The Director of Small Business Enterprise and the Contract Administration Supervisor sets the annual SBE participation contracting/subcontracting aspirational SBE goals for each contract. The contracting/subcontracting goals for this contract will be based on meeting or exceeding the **minimum aspirational SBE goal of 40%**, unless good cause exists for failing to meet the goal. The SBE aspirational goal is based on the total dollar amount of the contract.

To be recognized as an SBE, firms (contractors and/or subcontractors):

- a) Must be certified as an SBE by the following County approved entities: North Texas Regional Certification Agency (NCTRCA), DFW Minority Supplier Development Council and/or the Women's Business Council of Southwest, at the time of the proposal/bid submission. Other certifications are not acceptable;
- b) To be recognized by the County as a **qualified SBE firm**, as defined pursuant to Section 3 of the Small Business Act and relevant regulations, an SBE is a firm for which the gross revenues or number of employees averaged over the past three years, inclusive of any affiliates, is as defined by 13 C.F.R. Sec. 121.201; and
- c) Must also perform a commercially useful function on the project and have a local presence in Dallas County Metropolitan Statistical Area (MSA) in order to be counted for SBE points. The MSA includes the following counties: Dallas, Tarrant, Denton and Collin.

7.3 Utilization

The aspirational SBE or certified sub-contractor goal is expressed as a percentage of the total dollar amount of the contract going to SBE or certified Sub-Contractor for those areas which the Contractor has sub-contracted or anticipates sub-contracting. The aspirational goal shall also apply to contract amendments that require work beyond the scope of services originally required to accomplish the project.

The Respondent agrees to employ good faith efforts through the award of subcontractors to eligible SBEs and certified firms to the fullest extent possible.

Dallas County's Good Faith Effort Plan (GFEP) will be used to document SBE participation. However, all subcontractors and/or suppliers, whether certified or not, must be listed in the GFEP. The information provided

in the GFEP Form will be utilized in the development of the final contract/agreement. The GFEP Form can be found in the attachments. This form is required and considered to be a part of the response to the IFB.

Should the Good Faith Effort Plan or any of the specified documents listed below be incomplete, not signed, and/or not submitted, the bid can be deemed non-responsive.

7.4 Each Contractor must include with its proposal/bid, the following documents:

- Completed and signed **Good Faith Effort Plan**, executed by an authorized representative;
- Completed and signed **Small Business Utilization Affidavit**, executed by an authorized representative; and
- A signed and executed **Subcontractor Intent Form**, executed by an authorized representative (prime and subcontractor).

Note: All forms must be complete in their entirety and submitted as part of a Respondent's submittal.

The County reserves the right to accept or reject any certified firm and in its sole discretion is not bound by the certifying bodies' determination, if the County has a concern regarding the eligibility of the firm to meet SBE guidelines or standards. A Contractor whose proposed certified firm is rejected may contest in writing to the Office of Small Business Enterprise, in accordance with the SBE Policy. The denial of SBE certification by the Office of Small Business Enterprise is excluded from the Dallas County Purchasing Code of Ethics Protests Procedure and is exclusively governed by the appeal process set forth in the SBE Policy.

7.5 SBE Reporting. The Contractor and its subcontractors are required to electronically submit subcontractor payment information using the County's Compliance Reporting System (CRS), accessed through a link on the Dallas County SBE webpage. The Contractor and all subcontractors will be provided a unique log-in credential and password to access Compliance Reporting System.

Training on the use of the system will be provided by both Dallas County's CRS Support Staff and by the Office for Small Business Enterprise. Additional information and free online training for CRS can be found at <https://dallascounty.diversitycompliance.com>. After the prime receives payment from the County, electronic submittals will require data entry of the amount paid to each subcontractor listed on the Contractor's Good Faith Effort Plan.

7.6 Contracting. If awarded the contract, the Contractor agrees to be bound by the policies and guidelines set forth in the County's SBE Policy, which may be incorporated into the contract. If a conflict exists between the SBE section of the solicitation and the County SBE Policy, the language in the solicitation governs.

**MANDATORY
SBE SOLICITATION ATTACHMENTS**



SMALL BUSINESS UTILIZATION AFFIDAVIT

It is the policy of Dallas County to encourage the inclusion of qualified Small Business Enterprises (SBEs) to the greatest extent feasible on the County's construction, procurement and professional services contracts. Neither the County, nor its Contractors and their subcontractors shall discriminate on the basis of race, age, color, religion, national origin, or sex in the award and performance of contracts. In consideration of this policy, Dallas County has adopted the Small Business Enterprise Policy for all County contracts.

Small Business Enterprise Participation Goals

The solicitation bidding plan establishes subcontracting goals and requirements for all prospective bidders to ensure reasonable degree of SBE meaningful business utilization and participation in County contracts. It is the goal of Dallas County that a certain percentage of work under each contract be executed by one or more SBEs. For the purposes of participation percentages, Dallas County does not include amounts paid to the prime by the sub-contractor.

The apparent proposer shall agree to meet the established goals or must demonstrate and document a "good faith effort" to include SBEs in subcontracting opportunities. The apparent proposer who fails to adequately document good faith efforts to subcontract or purchase significant material supplies from SBEs may be denied award of the contract by Dallas County based on the contractor's failure to be a "responsive" or "responsible" bidder.

By signing below, I agree to provide Dallas County, Small Business Enterprise Department a completed copy of all required forms. I understand that, for the purpose of SBE subcontracting participation, any amounts paid to the prime from the sub-contractor should not be included in the above listed participation amount. Finally, I understand that if I fail to provide all of the required documents within five (5) business days after notification, my bid may be deemed "non-responsive" and I may be denied award of the contract.

Solicitation Number: _____

Company Name: _____

Typed or Printed Name of Certifying Official of Company

Date

Signature of Certifying Official of Company

Title



Small Business Enterprise Program Utilization Form

Solicitation/Project Name: _____ Solicitation #: _____

Firm Name: _____ Firm Phone # _____

Firm Address: _____ City: _____ State: _____ Zip: _____

Compliance Contact: _____ Phone #: _____ Email Address: _____

Is Your Firm Certified: _____ Certifying Agency: DFWMSDC _____ NCTRCA _____ WBC-Southwest _____ Other: _____

Total Bid Amount: _____ Amount self-performed: _____ Percentage self-performed: _____

Utilization Plan

List the firms that will be utilized on the project. Provide copies of correspondence.

SBE certified subcontractors/suppliers									
Firm Name & SBE Certification #	Tier	Person Contacted & Date	Address	Phone & Email Address	Type of Work	NAICS Code	Local or Non-Local	Dollar Amount	% of contract
							Total	\$	%

Small Business Enterprise

[Records Building](#) - 500 Elm Street, Suite 0300, Dallas, TX 75202
Telephone: (214) 653-6021 | E-Mail: sbe@dallascounty.org



Non SBE certified subcontractors/suppliers									
Firm Name	Tier	Person Contacted & Date	Address	Phone & Email Address	Type of Work	NAICS Code	Local or Non-Local	Dollar Amount	% of Total Contract
							Total	\$	%

Prime Printed Name: _____ Title: _____ Signature: _____ Date: _____

For Use by SBE Office Only

SBE Compliance Officer: _____ Date: _____

SBE Notes:



Good Faith Efforts Form

The Good Faith Efforts Form must be fully completed if the aspirational goal is **not** met.

1. Did you speak with or receive assistance from a staff member in the Small Business Enterprise

Department? _____ (Y/N) Name of staff member _____

2. Did you utilize a Dallas County SBE vendor list? If not, please explain?

Vendor List Accessed	Date of Access

3. Did you provide written notice to potential SBE subcontractors, suppliers, and vendors? Written notice should include plans, specifications, subcontractor/supplier opportunities, and deadline for submission to respondent no less than 7 days before bid submission. Please provide copies of all correspondence, including accepted and rejected SBE bids or proposals, i.e. letters, memos, emails and phone calls.

Firm Name & Address	Phone #	Person Contacted & Date	Type of Work	NAICS Code	SBE Certification No.	Response to Solicitation	Bid/Quote Amount	Company Selected (Y or N)

4. If applicable, did you participate in the pre-bid meeting? _____

Small Business Enterprise

[Records Building](#) - 500 Elm Street, Suite 0300, Dallas, TX 75202
Telephone: (214) 653-6021 | E-Mail: sbe@dallascounty.org



5. Did you identify and select specific work items to be performed and/or procurement to be fulfilled by SBEs? Please subdivide total contract work into smaller portions or quantities to permit maximum active participation by SBEs.

1.	2.	3.
4.	5.	6.

6. Did you advertise in trade publications or with local advocacy organizations? The advertisement must identify and describe subcontracting opportunities in detail, including a contact person and deadlines. Please provide a copy.

Publication Name	Date of Publication

Prime Printed Name: _____

Title: _____

Signature: _____

Date: _____

Small Business Enterprise

[Records Building](#) - 500 Elm Street, Suite 0300, Dallas, TX 75202
Telephone: (214) 653-6021 | E-Mail: sbe@dallascounty.org



**DALLAS COUNTY
SUBCONTRACTOR INTENT FORM**

To: Dallas County - Small Business Enterprise Department

Date: _____

Project Name: _____

Solicitation #: _____

_____ will provide the following good(s)/service(s):
Subcontractor on the project

to _____
Prime Contractor on the project

SBE subcontractor is certified by the following agency: ☐ DFW Minority Supplier Development Council ☐ NCTRCA ☐ Women's Business Council SW

SBE Certification #: _____ (Certification must be kept current/valid for the entire duration of this contract. Failure to comply with this provision could be subject to removal from contract.)

For the purposes of SBE subcontracting participation, Dallas County does not include amounts paid to the prime by the sub-contractor.

Total Contract Amount for prime: \$ _____

Estimated Work Start Date: _____

Sub Participation Amount: \$ _____ %

Estimated Work End Date: _____

The undersigned intends to enter into a formal agreement with the subcontractor listed, conditioned upon being awarded the Dallas County contract. The undersigned understands that, for the purpose of SBE subcontracting participation, any amounts paid to the prime from the sub-contractor should not be included in the above listed participation amount. **Before any subcontractor/supplier substitutions are made, the prime contractor must submit an SBE Substitution Request Form to The SBE Department for approval.** Failure to comply with these provisions could result in termination of the contract, sanctions against the prime contractor, and/or ineligibility for future Dallas County contracts. The subcontractor's participation will be entered in B2GNow, Dallas County's compliance system, based upon this intent form.

Officer's Signature (Prime Contractor)

Officer's Signature (Subcontractor)

Printed Name (Prime Contractor)

Printed Name (Subcontractor)

Title (Prime Contractor)

Title (Subcontractor)

Date

Date

Please select or list all Chambers or Advocacy groups you are a member of:

	Prime	Sub
Greater Dallas Asian American Chamber of Commerce	☐	☐
Greater Dallas Black Chamber of Commerce	☐	☐
Greater Dallas Hispanic Chamber of Commerce	☐	☐
U.S. Pan Asian American Chamber of Commerce	☐	☐
Asian Contractors Association	☐	☐
Regional Black Contractors Association	☐	☐
Regional Hispanic Contractors Association	☐	☐

Solicitation Number No.: 2026-007-7092 Pre-Bid Meeting Date: 12/18/2025 @ 10:30 AM
Project Title: George Allen Air Replacement of 3 Air Handler Units and HVAC Coils
Bid Due Date: January 29,2026 @ 2:00 PM



INVITATION FOR BID

George Allen Air Replacement of 3 Air Handler Units and HVAC Coils

Scope of Work/Specifications

I. Introduction

This project includes the replacement of steam and chilled water coils in multiple existing air handler units (AHU) and associated duct revisions on level 9 at George Allen Courthouse. Also, the replacement of one air handler unit (AHU) and combining two existing air handler units into one unit located at basement level B1. This project will be a one-time contract award. The County expects all work to be completed within the established timeframe, adhering strictly to the standards outlined in the Construction Documents.

II. Specification

See Exhibit A Project Manual and Exhibit B Issue for Bid Set.

III. References

Dallas County request reference letters from at least three sources/customers where the bidder has provided services of similar size and scope for all solicitations that will result in services.

IV. Pre-Bid Meeting Schedule, Questions, and Inquiries

During the solicitation process bidders are required to limit their communication regarding this project to the Buyer referenced herein. A pre-bid meeting will be held by the County whereby the bidders will have an opportunity to ask the requesting department(s) questions and/or obtain clarification. The pre-bid meeting will be the only time when bidder and requesting department(s) will communicate directly, thereafter, all communication associated with this project shall be address through the County's purchasing platform, (<https://www.bidnetdirect.com/texas/dallas-county>), to the assigned Buyer. The County will respond to all questions by way of addendum which will be posted as part of the solicitation. The County, its agents, and employees shall not be responsible for any information given by way of verbal communication.

Pre-bid conference **December 18, 2025 at 10:30 a.m. (CST)**, the pre-bid meeting will be conducted through a conference call.

https://teams.microsoft.com/l/meetup-join/19%3ameeting_OTAzM2FiM2ItNTg4YS00NzVILTg3ZDQtN2Q4OTRjZmY3M2M0%40thread.v2/0?context=%7B%22Tid%22%3A%2251adcfad-72f1-479c-b28f-52412e04014b%22%2C%22Oid%22%3A%226f7e6e0d-1f84-43a8-a037-

Solicitation Number No.: 2026-007-7092 Pre-Bid Meeting Date: 12/18/2025 @ 10:30 AM
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[c8b93e424cb8%22%2C%22IsBroadcastMeeting%22%3Atrue%2C%22role%22%3A%22a%22%7D&btype=a&role=a](#)

The deadline for the submission of questions is on **December 18, 2025 at 4 p.m. (CST)** through BidNet.

V. Term and Commencement Date

This will be a **one-term** contract with **no renewal options** commencing upon award by Commissioners Court, upon meeting any insurance and/or bonding requirements (if applicable) and/or fully executing the contract (if applicable).

VI. Award Method

The County's intent is to award this solicitation in its *entirety*, but the County reserves the right to award in the method that is most advantageous to the County.

The County reserves the sole discretion to determine whether a solicitation response is responsive. County reserves the right to reject any or all bids and to waive minor irregularities or discrepancies in any solicitation response as may be in the best interest of County. Late bids will not be considered for award.

For this solicitation the bidder must bid on all lines to be considered responsive.

Upon expiration of the Contract, the Contractor agrees to hold over under the terms and conditions of this contract for such a period of time as is reasonably necessary to re-solicit (not to exceed 90 calendar days unless mutually agreed on in writing).

VII. Bid Submittal and Exception Requirements

To be considered for award, the bid response must be submitted by **January 29, 2026** at 2:00 p.m. (CST). Bid responses shall be submitted electronically through BidNet, the County's online public solicitation platform (<https://www.bidnetdirect.com/texas/dallas-county>). Although the County prefers submissions in electronic form, a bidder may elect to submit their bid in hard copy. To submit in hard copy, the vendor may deliver or ship to: Dallas County Purchasing Department, Records Building 500 Elm Street, Suite 5500, Dallas, Texas 75202. When submitting a bid in hard copy, the County requires **two (2)** duplicate hardcopies (one original and one copy) to be submitted.

Any exceptions to the specifications/scope of work and/or terms and conditions shall be included in the solicitation response and shall appear in its own tab. Exception shall reference the page number, section and language for which exception is taken. The County reserves the right to reject any exception not in the best interest to the County or may lead the bid to be considered nonresponsive and not considered for award.

Note: On December 19, 2024, Dallas County implemented a new public solicitation platform and will be posting all solicitations for goods, services, and construction through BidNet. Vendors seeking to do business with Dallas County will be required to register, use this link to begin your registration. (<https://www.bidnetdirect.com/texas/dallas-county>). By registering, vendors will be able to receive, at no cost, solicitation notices, view open solicitations, and submit their response online to desired business opportunities.

VIII. Communication

Upon release of the solicitation and during the process, vendors /firms and their employees of related companies as well as paid or unpaid personnel acting on their behalf shall not contact or participate in any type of contact in relation to this solicitation with Dallas County employees, department heads and/or elected officials. Such contact may result in the vendor being disqualified. All questions and request for information related to this solicitation must be coordinated through Kelli Wright.

All questions regarding this solicitation are to be submitted in writing to **Kelli Wright**, Dallas County Purchasing Department via **BidNet** (<https://www.bidnetdirect.com/texas/dallas-county>), the County's procurement platform. If the bidder does not have access to the County's solicitation platform, the bidder may submit their questions in writing via email to Kelli.wright@dallascounty.org . Please reference the IFB Solicitation number in the subject of the email.

All questions, comments and requests for clarification must reference the IFB solicitation number on all correspondence to Dallas County. Any oral communications shall be considered unofficial and non-binding.

Only written responses to written communication shall be considered official and binding upon the County. The County reserves the right, at its sole discretion, to determine appropriate and adequate responses to the written comments, questions, and requests for clarification.

NOTE: All addenda and/or any other correspondence (general information, question and responses) to this IFB will be made available exclusively through the Dallas County website for retrieval. Bidders are solely responsible for frequently checking this website for updates to this IFB. Addenda can be located at the following web address: <http://www.dallascounty.org/departments/purchasing/currentbids.php> (go to the appropriate IFB number, click on the appropriate hyperlink to view and/or download solicitation.)

IX. Location and Invoicing

The County shall pay invoices in 30 days. In order for the County to pay invoices in 30 days, the vendor's invoice must be correct, and reflect the work or goods delivered to the County. The 30 days begin when the County has received a correct invoice reflecting the work or goods delivered. If the County receives an invoice that is not correct and/or reflective of work or goods that have been delivered, the County will request a corrected invoice and the 30-day period will begin once the correct invoice has been received. All work described in the vendor invoice must have been delivered in compliance with the terms of the contract.

Invoices shall be submitted monthly to the County for payment, unless both parties agree to alternative arrangement based on project milestones. Each invoice submitted for payment shall include, at a minimum, the following information:

- Name and address of the department for which services were provided
- Purchase order number
- Contact information of County staff who placed order (name, phone number, department)
- Date of order or Service
- Detailed description of each service

Solicitation Number No.: 2026-007-7092 Pre-Bid Meeting Date: 12/18/2025 @ 10:30 AM

Project Title: George Allen Air Replacement of 3 Air Handler Units and HVAC Coils

Bid Due Date: January 29,2026 @ 2:00 PM

- Price of good or services (charges for all services covered by PO/contract are to be separately stated and explained
- Unit pricing
- Total cost of goods/services

Submitting invoices without the above information will cause delays in payment processing. The County will not be responsible for payment delays due incorrect invoices or invoices sent to the wrong address.

X. Documents Submitted with Bid

1. Attachment S - Small Business Enterprise (SBE) Forms must be submitted with bid.
2. W-9 form signed in 2026

XI. Opening of Bids

Bid reading shall be conducted at 2:30pm (CST) on the day the bids are due. The reading will be conducted via a live meeting online at (insert bid opening link here). Bids will be publicly opened in compliance with public bid opening statutory requirements.

XII. Review of Bids

1. The County will review bids complying with the due date and time to determine whether bids are responsive and responsible and whether the bid meets minimum requirements.
2. The County may conduct all necessary inquiries or investigations, including but not limited to, contacting references to verify the statements, documents, and information submitted in connection with the bid.
3. Please be aware that Dallas County may use sources of information not supplied by the bidder concerning the abilities to perform this work or meet the minimum requirements. Such sources may include current or past customers of the organization; current or past suppliers; articles from industry newsletters or other publications or from non-published sources made available to Dallas County.

XIII. Bid Pricing

1. Bid pricing shall be firm for the entire contract unless otherwise stated herein. Costs not included or calculated in the applicable unit prices as bid will not be paid by the County, regardless of the intentions of the bidder when the bid was submitted and regardless that those costs were actually incurred.

XIV. Insurance Requirements

Any Contractor or Vendor that conducts business with Dallas County, whether it is for goods and/or services, must maintain lawful worker's compensation/self-insured employee coverage requirements and adequate liability limitations

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Within ten (10) days after contract award or prior to the commencement of any work or delivery, the Purchasing Agent requires the successful Contractor(s)/Vendor(s) to submit verification of the following coverage. The insurance coverages, except Workers Compensation and Professional Liability, required by this Contract, shall name Dallas County and its elected and appointed boards, officers, officials, agents, representatives, directors, employees and volunteers, as additional insured(s) (as the interest of each insured may appear).

Contractor at its own expense, consistent with its status as an independent contractor will carry, purchase and maintain insurance coverage, the minimum insurance coverage set forth immediately below, with companies authorized to do insurance business in the State of Texas or eligible surplus lines insurers operating in accordance with the *Texas Insurance Code*, having an A.M. Best Rating of "A" or better, and in amounts not less than the following minimum limits of coverage:

The policies may provide coverage, which contains deductibles or self-insured retention. Such deductibles and/or self-insured retention shall not be applicable with respect to the coverage provided to Dallas County under such policies. The Contractor shall be solely responsible for all deductibles and/or self-insured retention.

All insurance required herein shall be maintained in full force and effect throughout the term of this contract, including all extensions or renewals.

- 1.1. Workers Compensations and Employer's Liability Insurance or self-insured employee in the amount and in compliance with the provisions as provided for by Texas Law as established by the Texas Workers Compensation Act, Title 5, Subtitle A, Texas Labor Code for all his employees assigned to operate or work under this Contract. In the event the Contractor elects to sublet any work, Contractor shall require Sub-Contractors to provide Workers' Compensation Insurance for all of the latter's employees unless the Contractor affords such employees protection. Contractors shall be responsible for workers' compensation insurance for subcontractors or sub-lessees who directly or indirectly provide service under Dallas County contract.

Workers' Compensation Insurance with statutory limits, and Employer's Liability Insurance with limits of not less than \$500,000:

Employers Liability - Each Accident	\$500,000
Employers Liability - Each Employee	\$500,000
Employers Liability - Policy Limit	\$500,000

Policies under this Section shall apply to State of Texas and include the following endorsements in favor of Dallas County:

- a. Waiver of Subrogation
- b. Thirty (30) day Notice of Cancellation

- 1.2. Commercial General Liability: Contract shall maintain Commercial General Liability Insurance coverage must include the following: (a) Premises; (b) Operations; (c) Independent Contractor's Protective Liability; (d) Products and Completed Operations; (e) Medical Expense; (f) Personal and Advertising Injury; (g) Contractual Liability; (h) Broad form property damage, to include

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fire legal liability. Such insurance shall carry in an amount not less than One Million and 00/100 (\$1,000,000.00) for bodily injury (including death), property damage, and blanket contractual coverage per occurrence with a general aggregate of Two Million and 00/100 (\$2,000,000.00) and products and completed operations aggregate of Two Million and 00/100 (\$2,000,000.00).

Policies under this Section shall apply to State of Texas and include the following endorsements in favor of Dallas County:

- a. Waiver of Subrogation
- b. Thirty (30) day Notice of Cancellation
- c. Additional Insureds: Dallas County and its elected and appointed boards, officers, officials, agents, representatives, directors, employees and volunteers.

- 1.3. Automobile Liability Insurance: Contractor shall maintain Automobile Liability Insurance covering all owned, hired and non-owned automobiles used in connection with work with limits not less than Five Hundred Thousand 00/100 (\$500,000.00) Combined Single Limit of Liability for Bodily Injury and Property Damage. Such insurance is to include coverage for loading and unloading hazards.

Policies under this Section shall apply to State of Texas and include the following endorsements in favor of Dallas County:

- a. Waiver of Subrogation
- b. Thirty (30) day Notice of Cancellation
- c. Additional Insureds: Dallas County and its elected and appointed boards, officers, officials, agents, representatives, directors, employees and volunteers.

- 1.4. Builders Risk Insurance: Contractor shall maintain during the term of this contract, at its own expense, All Builders Risk Insurance in the amount equal to one hundred percent (100%) of the initial contract amount plus values of subsequent modifications and change orders. Covered perils shall include but not be limited to: Contractor's labor and workmanship, materials, fixtures, equipment, defects, fire, wind, lightning, and other weather-related hazards, damage, extended coverage, vandalism, and malicious mischief, and theft.

Policies under this Section are subject to the laws of the State of Texas and include the following endorsements in favor of Dallas County

- a. Name Dallas County as loss payee as its interest may appear
- b. Thirty (30) day Notice of Cancellation

- 1.5. Bid Security or Bid Bond (for contracts in excess of \$100,000): All bids shall be accompanied by a cashier's check, certified check, or a bid bond in an amount of not less than five percent (5%) of the total bid. All cashier's check or certified check shall made payable without conditions to Dallas County and must reference the IFB number on the check or bond. Bid bond executed by a solvent corporate surety or corporate sureties which are on the approved list of the United States Department of Treasury (Federal register Circular 570 - "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and Acceptable Reinsuring Companies", Sections 9304 through 9308 of Title 31 of the United States Code. Surety

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Companies Acceptable on Federal Bonds. The Surety must also be duly authorized to do business in the State of Texas.

- 1.6. Performance Bond (for contracts in excess of \$50,000): Contractor within ten (10) days after contract award or prior to the commencement of any work or delivery services under this contract Contractor shall furnish to the County a Performance Bond in the amount equal to one hundred percent (100%) of the contract amount, executed by a solvent corporate surety or corporate sureties which are on the approved list of the United States Department of Treasury (Federal register Circular 570 - "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and Acceptable Reinsuring Companies", Sections 9304 through 9308 of Title 31 of the United States Code. Surety Companies Acceptable on Federal Bonds. The Surety must also be duly authorized to do business in the State of Texas.
- 1.7. Payment or Material and Labor Bond (for contracts in excess of \$25,000): Contractor within ten (10) days after contract award or prior to the commencement of any work or delivery services under this contract Contractor shall furnish to the County a Payment or Material and Labor Bond in the amount equal to one hundred percent (100%) of the contract amount, executed by a solvent corporate surety or corporate sureties which are on the approved list of the United States Department of Treasury (Federal register Circular 570 - "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and Acceptable Reinsuring Companies", Sections 9304 through 9308 of Title 31 of the United States Code. Surety Companies Acceptable on Federal Bonds. The Surety must also be duly authorized to do business in the State of Texas.

The bonds must clearly and prominently display on the bond or on an attachment to the bond the name, mailing address, physical address, and telephone number, including the area code, of the surety company to which any notice of claim should be sent, or the toll-free telephone number maintained by the Texas Department of Insurance under Chapter 521.051 of the Texas Insurance Code, and a statement that the address of the surety company to which any notice of claim should be sent may be obtained from the Texas Department of Insurance by calling the toll free telephone number.

In the event the contract is prematurely terminated due to Contractor's breach and/or nonperformance of the contract, the County reserves the right to act on the performance bond and/or seek monetary restitution. In the event civil suit is filed to enforce this provision, County will seek its attorney's fees and costs of suit from Contractor which amount Contractor shall pay in the event that County prevails in such action.

All bonds shall be delivered to the Dallas County Purchasing Agent located at 500 Elm Street, 5th Floor, Suite 5500, Dallas, Texas 75202. No work shall be authorized until the bond has been submitted to Dallas County Purchasing Agent.

Contractor agrees that, with respect to the above-referenced insurance, all insurance contracts/policies will contain the following required provisions:

- a. Endorsement: Except Workers Compensation and Professional Liability, name Dallas County and its elected and appointed boards, officers, officials, agents, representatives, directors, employees and volunteers as additional insured(s) (as the interest of each insured

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- may appear) as to all applicable coverage;
- b. Endorsement: Provide for thirty (30) days prior written notice will be given to the County for cancellation, non-renewal or material reduction/change in coverage provided under all policies, except in cases of cancellation for non-payment, in the event of which notice shall be provided as required by state law to Dallas County;
 - c. Endorsement: Contractor agrees to waive subrogation against Dallas County, its officers and employees for injuries, including death, property damage or any other loss;
 - d. Provide for endorsement that the “other insurance” clause shall not apply to County where County is the additional insured on the policy;
 - e. All insurance required herein shall be maintained in full force and effect until all work or services required to be performed under the terms of the contract is satisfactorily completed and formally accepted;
 - f. All insurance coverage shall be on a per occurrence basis, if coverage is written on a claims-made basis, the retroactive date shall be prior to or coincide with the date of the Contract and the certificate of insurance shall state that the coverage is claims-made and indicate the retroactive date. The coverage shall be continuous for the duration of the contract agreement and for not less than two (2) years following the end of the contract agreement. Coverage, including renewals, shall have the same retroactive date as the original policy applicable to the contract agreement;
 - g. Contractor shall be solely responsible for the deductible and/or self-insured retention for any loss;
 - h. Contractor insurance policies coverage shall be written on a primary basis and non-contributory with any other insurance coverages and/or self-insurance carried by Dallas County;
 - i. Default/Cumulative Rights/Mitigation. It is not a waiver of default if the non-defaulting party fails to immediately declare a default or delays in taking any action. The rights and remedies provided by this contract agreement are cumulative, and either Party’s use of any right or remedy will not preclude or waive its right to use any other remedy. These rights and remedies are in addition to any other rights the Parties may have by law, statute, ordinance or otherwise. Contractor has a duty to mitigate damages.
 - j. Approval and acceptance of Contractor’s services and work by County shall not constitute nor be deemed a release of the responsibility and liability of Contractor for the accuracy and competency of Contractor’s services or work; nor shall such approval and acceptance be deemed to be an assumption of such responsibility by the County for any defect, error or omission in the services performed by Contractor in this regard;
 - k. Contractor shall provide that all provisions of this contract agreement concerning liability, duty and standard of care, shall be underwritten by contractual liability coverage sufficient to include obligation within applicable policies;
 - l. Contractor and their freight contractors must be prepared to show coverage verification prior to entering upon County premises;
 - m. Failure to comply with lawful requirements or adequate liability requirements may result in delay of payments, subject to the orders of the Commissioners Court, not to exceed a period of up to two years from the termination of this contract agreement, or cancellation of this contract agreement or both (Dallas County Commissioners Court Order 2003-1792, September 30, 2003);

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- n. Insurance Certificates: The certificates of insurance shall list County as the certificate holder. Any and all copies of Certificates of Insurance shall reference any applicable (Bid Number, Commissioners Court Order Number, or contract number for which the insurance is being supplied). All insurance policies or duly executed certificates for the same required to be carried by Contractor under this contract agreement, together with satisfactory evidence of the payment of the premium thereof, shall be delivered to the: Dallas County Purchasing Agent located at 500 Elm Street, Suite 5500, Dallas, Texas 75202; and
- o. All insurance required to be carried by Contractor or subcontractors under this contract agreement shall be acceptable to the County in form and content, in its sole discretion. All policies shall be issued by an insurance company acceptable and satisfactory to County and authorized to do business in the State of Texas. Acceptance of or the verification of insurance by County shall not relieve or decrease the liability of Contractor.

2. Insurance Lapse

In the event successful firm fails to maintain insurance as required by this contract, successful firm shall immediately cure such lapse in insurance coverage at successful firm's sole expense and pay County in full for all costs and expenses incurred by County under this contract as a result of such failure to maintain insurance by successful firm, including costs and reasonable attorney's fees relating to County's attempt to cure such lapse in insurance coverage. Such costs and attorney's fees, not to exceed fifteen hundred and 00/100 dollars (\$1,500.00), shall be automatically deducted from monies or payments owed to successful firm by County. Moreover, the County shall retain five percent (5%) of the value of the Contract that shall be placed into an account from monies or payments owed to Contractor by County to cover County's potential exposure to liability during the period of such lapse. The five percent (5%) retainage shall be held by County until six (6) months after the date lapse in coverage is cured or Term of the Contract has ended or has otherwise been terminated, canceled or expired and shall be released if no claims are received or lawsuits filed against County for any matter that should have been covered by the required insurance. The County shall retain the funds if a claim is received or lawsuit and use the funds to defend, pay costs of defense or settle the claim.

XV. Rejection or Acceptance of Bids

The County reserves the right to accept or reject in part or in whole any bids submitted. The Purchasing Agent will recommend to Commissioners Court award to the lowest responsive and responsible bidder as determined by the Purchasing Agent.

XVI. Late and Withdrawn Bids

All bids must be submitted no later than the bid due date and time established by this solicitation. Bid arriving after the due date and time will not be accepted. Late bids delivered by carrier will be return to the bidder unopened.

A bidder has the right to withdraw their bid prior to the bid due date and time, thereafter, the bidder shall submit a formal request to the Dallas County Purchasing Agent requesting to withdraw their bid.

XVII. Confidentiality

Any information deemed confidential, shall be clearly noted as such on each page of the solicitation response by the bidder. County cannot guarantee it will not be compelled to disclose all or part of any public record under the Texas Open Record Act. Respondents who include information in a bid that is legally protected as trade secret or confidential shall clearly indicate the information which constitutes a trade secret or confidential information by marking that part of the bid “trade secret” or “confidential” at the appropriate place. If a request is made under the Texas Open Records Act to inspect information designated as trade secret or confidential in a bid, the bidder shall, upon request, immediately furnish sufficient written reasons and information as to why the information designated as a trade secret or confidential should be protected from disclosure to Attorney General of Texas for final determination.

XVIII. Disqualification of Bidders

Bidders may be disqualified for, but not limited to, the following reasons:

- Reason to believe collusion exists among the bidders
- The bidder is involved in any litigation against Dallas County
- The bidder is in arrears on an existing contract or has failed to perform on a previous contract with Dallas County

XIX. Permits Required by Law

Contractor shall comply with all requirements of federal, state, and local statutory requirements and regulations pertinent to or affecting any phase of this contract.

XX. Records and Audit

The Contractor shall keep accurate records of all components of invoices to the County as they relate to this contract. These records shall be retained for a minimum of two years after the conclusion of the Contract. The County reserves the right to audit any records it deems necessary for the execution of this Contract.

XXI. Assignment of Contract

The Contractor shall not assign, transfer, sublet, convey or otherwise dispose of the Contract of any part therein or its right, title or interest therein or its power to execute the same to any other persons, firm, partnership, company or corporation without the prior written consent of the County. Should the Contractor assign, transfer, sublet, convey or otherwise dispose of its right, title or interest or any part thereof in violation of this section, the County may, at its discretion, cancel the Contract and all rights, title and interest of the Contractor shall therein cease and terminate, and the Contractor shall be declared in default.

XXII. Default by Contractor

The following events shall be deemed to be events of default by Contractor under the Contract:

- Contractor shall become insolvent, or shall make a transfer in fraud of creditors, or shall make an assignment for the benefit of creditors;

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- Contractor attempts to assign the Contract without the prior written consent of the County;
- Contractor shall fail to perform, keep or observe any term, provision or covenant of the Contract; or
- Contractor fails to properly and timely pay Contractor personnel, suppliers or other contractors and the failure impacts the County in any manner.

In the event a default occurs, the Director shall give the Contractor written notice of the default. If the default is not corrected to the satisfaction and approval of the Director within the time specified in such notice, the County may immediately cancel the Contract. At the direction of the Director, the Contractor shall vacate the facility, if applicable, and shall have no right to further operate under the Contract.

The Contractor, in accepting the Contract, agrees that the County shall not be liable to prosecution for damages or lost anticipated profits if the County cancels or terminates the Contract.

No Waiver: No waiver by the County of any default or breach of any covenant, condition, or stipulation shall be treated as a waiver of any subsequent default or breach of the same or any other covenant, condition, or stipulation.

XXIII. Termination

The County may terminate this agreement in whole or in part by giving thirty days written notice thereof to Contractor. The County will compensate Contractor in accordance with the terms of the agreement for all goods and services delivered and accepted prior to the effective date of such termination notice.

XXIV. Miscellaneous

1. After executing the contract or issuance of a purchase order, no consideration will be given to any claim of misunderstanding.
2. Bidders shall submit with their bid, the required Contractor's qualification statement with supporting information as stated herein along with all other supporting documentation requested.
3. Bidders shall thoroughly familiarize themselves with the provisions of these specifications/scope of work.
4. A bid may be disqualified if the corporation or individual bidder is in arrears or in default to the County for delinquent taxes or assessments or on any debt or contract, whether as defaulter or bondsman; or who has defaulted upon any obligation to the County by failing to perform satisfactorily any previous agreement or Contract within the past seven years. Also, bidders may be disqualified for poor prior performance on similar Contracts with other entities.
5. The Contractor agrees to abide by the rules and regulations as prescribed herein. The Contractor will, in all solicitations or advertisements for personnel to perform services under the Contract, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, gender, or national origin.
6. If either party hereto is prevented from completing its obligations under the Contract by act of God, strike, lockout, material or labor restrictions by any governmental authority, civil riot, flood, or any other cause beyond the control of the parties hereto, then such party shall be excused from such

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performance for such period of time as is reasonably necessary after such occurrence to remedy the effects thereof.

7. The section headings in these Specifications are for convenience in reference and are not intended to define or limit the scope of any of the conditions, terms or provisions of these specifications.
8. Should any question arise as to the proper interpretation of the terms and conditions of these specifications, the decision of the department director and/or Purchasing Agent or his authorized representative shall be final.

XXV. Indemnity

The selected bidder agrees to defend, indemnify and hold the County, its officers, agents and employees, harmless against any and all claims, lawsuits, judgments, costs, and expenses for personal injury (including death), property damage or other harm for which recovery of damages is sought, suffered by any person or persons, that may arise out of or be occasioned by the selected bidder's breach of any of the terms or provisions of the contract, or by any other negligent or strictly liable act or omission of the selected bidder, its officers, agents, employees, or subcontractors, in the performance of the contract; except that the indemnity provided for in this paragraph shall not apply to any liability resulting from the sole negligence or fault of the County, its officers, agents, or employees and in the event of joint and concurrent negligence or fault of the selected bidder(s) and County, responsibility, and indemnity, if any, shall be apportioned comparatively in accordance with the laws of the State of Texas, without waiving any governmental immunity available to the County under Texas law and without waiving any defenses of the parties under Texas law. The provisions of this paragraph are solely for the benefit of the parties hereto and are not intended to create or grant any rights, contractual or otherwise, to any other person or entity.

XXVI. Development Costs

Neither Dallas County nor its representatives shall be liable for any expenses incurred in connection with preparing a response to this IFB. Respondents are encouraged to prepare their bids simply and economically, providing a straightforward and concise description of your firm's ability to meet the requirements of the IFB.

XXVII. Certificate of Interested Parties (Form 1295)

Section 2252.908 of the Texas Government Code: An Act Addressing Disclosure of Interested Parties.

Effective January 1, 2016, Dallas County, must comply with the "Disclosure of Interest Parties, requirements established under Section 2252.908 of the Texas Government Code as implemented by the Texas Ethics Commission. Briefly stated, all contracts requiring an action or vote by the governing body of the entity or agency before the contract may be signed (regardless of the dollar amount) or that has a value of at least \$1 million will require the on-line completion of Form 1295 "Certificate of Interested Parties", in accordance with Texas Government Code Statute §2252.908. Form 1295 is also required for any and all contract amendments, extensions or renewals. All business entities are required to complete and file electronically with the Texas Ethics Commission using the online filing application.

Step 1: Business Entity completes Form 1295 in electronic format on the Texas Ethics Commission website: (https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm)

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Step 2: Upon receipt of a completed Interested Parties Disclosure Form, Texas Ethics Commission issues a Certification of Filing to the Business Entity and the Business Entity download(s), print, sign(s) and notarize(s) Form 1295. An authorized agent of the business entity will need to sign the printed copy of the form and have the form notarized.

Step 3: At the time of submission of the solicitation to Dallas County the Business Entity must submit the completed notarized Form 1295 with the Certification of Filing with their contract (i.e.: bid, rfp, rfq, soq, etc.) to Dallas County. Upon receipt, Dallas County may proceed with the award and/or execution of the contract.

Step 4: Not later than the 30th day after the date the contract has been signed by all parties, Dallas County must notify the Texas Ethics Commission (in electronic format) of the receipt of (1) Form 1295, and (2) the Certification of Filing.

Step 5: Not later than the 7th business day after receipt of the above notice, Texas Ethics Commission makes the disclosure available to the public by posting the disclosure on its website.

County Offices and Departments submitting contracts to Commissioners Court for award/execution are responsible for acknowledging and filing the Form 1295.

Definitions:

(a) “Contract” includes an amended, extended, or renewed contract.

(b) “Business entity” includes an entity through which business is conducted with a governmental entity or state agency, regardless of whether the entity is a for-profit or nonprofit entity. The term does not include a governmental entity or state agency.

(c) “Controlling interest” In accordance with the Texas Ethics Commission, Chapter 46.3(c) and applicable to Texas Government Code §2252.908 - (1) an ownership interest or participating interest in a business entity by virtue of units, percentage, shares, stock, or otherwise that exceeds 10 percent; (2) membership on the board of directors or other governing body of a business entity of which the board or other governing body is composed of not more than 10 members; or (3) service as an officer of a business entity that has four or fewer officers, or service as one of the four officers most highly compensated by a business entity that has more than four officers.

(d) “Interested party” (1) a person who has a controlling interest in a business entity with whom a governmental entity or state agency contracts; or (2) a person who actively participates in facilitating a contract or negotiating the terms of a contract with a governmental entity or state agency, including a broker, intermediary, adviser, or attorney for the business entity.

(e) “Intermediary” for purposes of this rule, means, a person who actively participates in the facilitation of the contract or negotiating the contract, including a broker, adviser, attorney, or representative of or agent for the business entity who:

(1) receives compensation from the business entity for the person’s participation;

(2) communicates directly with the governmental entity or state agency on behalf of the business entity regarding the contract; and

(3) is not an employee of the business entity.

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To obtain additional information on Section 2252 and to learn more about the Texas Ethics Commission process to create a new account or to complete an electronic version of Form 1295 for submission with a signed contract, please go to the following website:

<https://www.ethics.state.tx.us/tcc/1295-Info.htm>

Instructional Videos for Business Entities on how to file online can be found at:

https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm

XXVIII. Conflict of Interest

No County elected or appointed official or representative, or any employees shall have any financial interest, direct or indirect, in any contract with the County or be financially interested, directly or indirectly, in the sale to the County of any land, materials, supplies, goods or services, except on behalf of the County as an official or employee. Any violation of this Section, with knowledge, expresses or implied, of the person or corporation contracting with the County shall render this Agreement involved voidable by the Commissioners Court of Dallas County. It is the responsibility of Contractor during all phases of this Agreement to notify the County in writing of any potential conflict of interest. Contractor covenants that neither it nor any member of its corporation presently has any interest or shall acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance of this Agreement. Contractor further covenants that in the performance of this Agreement no person having such interest shall be employed or appointed by Contractor.

XXIX. Small Business Enterprise (SBE) Program

See Attachment S – Small Business Enterprise Program (SBE) and SBE forms



DALLAS COUNTY GEORGE ALLEN COURTHOUSE HVAC REPLACEMENT

2024354

ISSUE FOR BID
26 SEPTEMBER 2025

Kirksey
ARCHITECTURE

Houston + Austin + Dallas

(S) – authored by Structural Engineer

(A) – authored by Architect

(MEP) – authored by MEP Engineer

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DIVISION 09 — FINISHES		
09 91 00 PAINTING (A)	26 SEP 2025	

DIVISION 10 — SPECIALTIES

NOT USED

DIVISION 11 — EQUIPMENT

NOT USED

DIVISION 12 — FURNISHINGS

NOT USED

DIVISION 13 — SPECIAL CONSTRUCTION

NOT USED

DIVISION 14 — CONVEYING EQUIPMENT

NOT USED

DIVISION 20 — FACILITY SERVICES GENERAL REQUIREMENTS

NOT USED

DIVISION 21 — FIRE SUPPRESSION

NOT USED

DIVISION 22 — PLUMBING

22 05 17	SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING (MEP).....	26 SEP 2025
22 05 19	METERS AND GAUGES FOR PLUMBING PIPING (MEP)	26 SEP 2025
22 05 23	GENERAL-DUTY VALVES FOR PLUMBING PIPING (MEP)	26 SEP 2025
22 05 29	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT (MEP)	26 SEP 2025
22 05 53	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT (MEP) ...	26 SEP 2025
22 07 19	PLUMBING PIPING INSULATION (MEP)	26 SEP 2025
22 10 05	PLUMBING PIPING (MEP)	26 SEP 2025
22 10 06	PLUMBING PIPING SPECIALTIES (MEP)	26 SEP 2025
22 30 00	PLUMBING EQUIPMENT (MEP)	26 SEP 2025

DIVISION 23 — HEATING VENTILATING AND AIR CONDITIONING

23 00 10	BASIC MECHANICAL REQUIREMENTS (MEP)	26 SEP 2025
23 05 13	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT (MEP) ..	26 SEP 2025
23 05 19	METERS AND GAGES FOR HVAC PIPING (MEP)	26 SEP 2025
23 05 23	GENERAL DUTY VALVES FOR HVAC PIPING (MEP)	26 SEP 2025
23 05 29	HANGERS AND SUPPORT FOR HVAC EQUIPMENT (MEP)	26 SEP 2025
23 05 48	VIBRATION AND SEISMIC CONTROLS FOR HVAC (MEP)	26 SEP 2025
23 05 53	MECHANICAL IDENTIFICATION (MEP)	26 SEP 2025
23 05 93	TESTING, ADJUSTING, AND BALANCING FOR HVAC (MEP)	26 SEP 2025
23 07 13	DUCT INSULATION (MEP)	26 SEP 2025
23 07 19	HVAC PIPING INSULATION (MEP)	26 SEP 2025
23 08 00	COMMISSIONING OF HVAC (MEP)	26 SEP 2025
23 09 24	FACILITY MANAGEMENT CONTROL SYSTEM (TRIDIUM) (MEP).....	26 SEP 2025
23 09 25	VARIABLE FREQUENCY DRIVES (MEP)	26 SEP 2025
23 21 13	HYDRONIC PIPING (MEP)	26 SEP 2025
23 21 14	HYDRONIC SPECIALTIES (MEP)	26 SEP 2025
23 21 23	HYDRONIC PUMPS (MEP)	26 SEP 2025
23 25 00	HVAC WATER TREATMENT (MEP)	26 SEP 2025
23 31 00	HVAC DUCTS AND CASINGS (MEP)	26 SEP 2025
23 33 00	AIR DUCT ACCESSORIES (MEP)	26 SEP 2025
23 34 23	HVAC POWER VENTILATORS (MEP)	26 SEP 2025
23 36 00	AIR TERMINAL UNITS (MEP)	26 SEP 2025
23 52 16	CONDENSING BOILERS (MEP)	26 SEP 2025
23 64 23	SCROLL WATER CHILLERS (MEP)	26 SEP 2025
23 73 13	MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS (MEP)	26 SEP 2025

DIVISION 25 — INTEGRATED AUTOMATION

NOT USED

DIVISION 26 — ELECTRICAL

26 05 05	SELECTIVE DEMOLITION FOR ELECTRICAL (MEP).....	26 SEP 2025
26 05 19	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (MEP).....	26 SEP 2025
26 05 26	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS (MEP)	26 SEP 2025
26 05 29	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS (MEP)	26 SEP 2025
26 05 33.13	CONDUIT FOR ELECTRICAL SYSTEMS (MEP)	26 SEP 2025
26 05 33.16	BOXES FOR ELECTRICAL SYSTEMS (MEP)	26 SEP 2025
26 05 53	IDENTIFICATION FOR ELECTRICAL SYSTEMS (MEP)	26 SEP 2025
26 05 73	POWER SYSTEM STUDIES (MEP)	26 SEP 2025
26 05 83	WIRING CONNECTIONS (MEP)	26 SEP 2025
26 08 00	COMMISSIONING OF ELECTRICAL SYSTEMS (MEP)	26 SEP 2025
26 09 23	LIGHTING CONTROL DEVICES (MEP)	26 SEP 2025
26 24 13	SWITCHBOARDS (MEP).....	26 SEP 2025
26 24 16	PANELBOARDS (MEP)	26 SEP 2025
26 27 26	WIRING DEVICES (MEP).....	26 SEP 2025
26 28 13	FUSES (MEP).....	26 SEP 2025
26 28 16.16	ENCLOSED SWITCHES (MEP)	26 SEP 2025
26 29 13	ENCLOSED CONTROLLERS (MEP)	26 SEP 2025
26 51 00	INTERIOR LIGHTING (MEP).....	26 SEP 2025
26 56 00	EXTERIOR LIGHTING (MEP).....	26 SEP 2025

DIVISION 27 — COMMUNICATIONS

NOT USED

DIVISION 28 — ELECTRONIC SAFETY AND SECURITY

28 46 00	FIRE DETECTION AND ALARM (MEP)	26 SEP 2025

DIVISION 31 — EARTHWORK

NOT USED

DIVISION 32 — EXTERIOR IMPROVEMENTS

NOT USED

DIVISION 33 — UTILITIES

NOT USED

DOCUMENT 00 01 07.1 - ARCHITECT SEAL PAGE

All sections identified on the Table of Contents with a suffix of (A) have been furnished by the Architect for this Project:



26 SEPTEMBER 2025

DOCUMENT 00 01 07.4 – STRUCTURAL SEAL PAGE

All sections identified on the Table of Contents with a suffix of (S) have been furnished by **CLICK ENGINEERING** (Structural Engineer) for this Project:



STRUCTURAL SEAL

DOCUMENT 00 01 07.5 - MEP SEAL PAGE

All sections identified on the Table of Contents with a suffix of (MEP) have been furnished by **CAMPOS ENGINEERING** (Mechanical, Electrical or Plumbing Engineer) for this Project:



MECHANICAL SEAL



ELECTRICAL SEAL

SECTION 01 10 00 - SUMMARY**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:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Work by Owner.
 - 4. Owner-furnished products.
 - 5. Access to site.
 - 6. Work restrictions.
 - 7. Specification and drawing conventions.

1.3 PROJECT INFORMATION

- A. Project Identification: Dallas County George Allen Courthouse HVAC Replacement, #2024354.
 - 1. Project Location: 600 Commerce Street Dallas, Texas 75202.
- B. Owner: Dallas County.
- C. Architect: Kirksey | Architecture
- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. Click Engineering - Structural
 - 2. Campos Engineering - MEP Consultant.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.5 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
- A. Owner Responsibilities: For Owner-furnished, Contractor-installed products, the Owner will:
 - 1. Arrange for Shop Drawings, Product Data, and Samples and deliver to the Contractor.
 - 2. Arrange and pay for delivery of Owner-furnished items according to Contractor's construction schedule
 - 3. Inspect delivered items for damage.
 - 4. Arrange for replacement of Owner-furnished items that are damaged, defective, or missing when delivered to Contractor.
 - 5. Arrange for manufacturer's field services for delivery of manufacturer's warranties to the Contractor.
 - 6. Furnish the Contractor the earliest possible delivery date for Owner-furnished products.
- B. Contractor Responsibilities: For Owner-furnished, Contractor-installed products, the Contractor shall:
 - 1. Provide support systems to receive Owner's equipment as well as provide plumbing, HVAC, and electrical connections.
 - 2. Be present for delivery and assist the Owner's inspection.
 - 3. Use Owner-furnished delivery dates in Contractor's construction schedule.
 - 4. Review Shop Drawings, Product Data, Samples, and other submittals, and return to the Architect, noting discrepancies or anticipated problems regarding incorporation of the product.
 - 5. Be responsible for receiving, unloading, handling, and storing Owner-furnished items at Project site.

6. Protect Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
7. Repair or replace items damaged because of Contractor's operations with new items matching originally specified items.

1.6 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours, Monday through Friday, unless otherwise indicated.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- F. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specifications Format: The Specifications are organized into Divisions and Sections using CSI/CSC's "MasterFormat 2020" 50-Division numbering system.
 1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence, without all numbers included in the sequence. Consult the Table of Contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
 2. The order of articles, paragraphs, subparagraphs, and sub-subparagraphs within the text of any Specification section is defined by a sequence of indentations.
 - a. Article, paragraph and subparagraph titles, and other identifications of subject matter in the Specifications, are intended as an aid in locating and recognizing various requirements in the beginning words of a sentence.
 - b. Specification text shall govern over titling and shall be understood to be interpreted as a whole. Where a title establishes the subject, the titles are subordinate to and do not define, limit, or otherwise restrict the Specification text.
 3. The captions and headings of various subdivisions of the Contract Documents are intended only as a matter of reference and convenience for describing the Work and in no way define, prescribe, or limit the scope or intent of the Contract Documents or any subdivision thereof.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - b. Contract Documents may omit modifying words such as "all" or "any," and articles such as "the" or "an." The absence of a modifier or article from one statement that appears in another is not intended to affect the interpretation of either statement.
 3. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
 4. The Specifications do not:
 - a. Establish trade jurisdictions or divisions of responsibility.
 - b. Define subcontract scopes of work.
 5. Work specified in any one Section is related to, and dependent upon, Work specified in other Sections, whether or not specific reference is made to the Work of other Sections. Cross-references in the Specifications are general references intended as a matter of convenience for aiding in the location general information and are not all-inclusive.
 6. Names, telephone numbers, and website addresses and other contact information listed in the Contract Documents are for convenience only, are subject to change, and are believed to be accurate and up to date as of the printing of the Contract Documents.
 7. Use of the word "including," when following any general statement, shall not be construed to limit such statement to specific items or matters listed, whether or not non-limiting language (such as "without limitation," "but not limited to," or other words of similar import) is used with reference thereto; but rather, shall be deemed to refer to all other items or matters that could reasonably fall within the broadest possible scope of such general statement.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS

2.1 HAZARDOUS MATERIALS

- A. Asbestos containing materials or lead-based paint are prohibited from being used on the Project.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES**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 substitutions.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES or other agency approved by local authority.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.

- m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Acceptance, if granted, will be based on reliance upon data submitted within substitution request and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered. Approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed.
 - c. In proposing items for consideration, Contractor assumes all risk, costs, and responsibility for item's final acceptance, compliance with Contract Documents, integration into the Work, and performance.
 - d. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.
- B. A Substitution Request for products, assemblies, and equipment constitutes a representation that the Contractor:
 - 1. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Has confirmed that the proposed substitution does not affect dimensions or functional clearances.
 - 3. Agrees to provide the same warranty for the substitution as for the specified product.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for no additional cost to the Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Requested substitution provides sustainable design characteristics that specified product provided.
 - c. Substitution request is fully documented and properly submitted.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.
 - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.
 - i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Requested substitution provides sustainable design characteristics that specified product provided
 - e. Substitution request is fully documented and properly submitted.
 - f. Requested substitution will not adversely affect Contractor's construction schedule.
 - g. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - h. Requested substitution is compatible with other portions of the Work.
 - i. Requested substitution has been coordinated with other portions of the Work.
 - j. Requested substitution provides specified warranty.
 - k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.1 ATTACHMENTS

- A. Substitution Request Form.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 25 00.13 - SUBSTITUTION REQUEST FORM

PROJECT: _____

(After Contract Award)

TO: _____

NO. _____

DATE: _____

Contractor hereby requests acceptance of the following product or system as a substitution in accordance with provisions of Division 01 Section "Substitution Procedures:"

1. SPECIFIED PRODUCT OR SYSTEM

Substitution request for: _____

Specification Section No.: _____ Article/ Paragraph: _____

2. REASON FOR SUBSTITUTION REQUEST**SPECIFIED PRODUCT . . .**

- ☐ Is no longer available.
- ☐ Is unable to meet project schedule.
- ☐ Is unsuitable for the designated application.
- ☐ Cannot interface with adjacent materials.
- ☐ Is not compatible with adjacent materials.
- ☐ Cannot provide the specified warranty.
- ☐ Cannot be constructed as indicated
- ☐ Cannot be obtained due to one or more of the following:
- ☐ Strike ☐ Bankruptcy of manufacturer or supplier
- ☐ Lockout ☐ Similar occurrence (explain below)

PROPOSED PRODUCT . . .

- ☐ Will reduce construction time
- ☐ Will result in cost savings of
\$ _____ to Project
- ☐ Is for supplier's convenience
- ☐ Is for subcontractor's
convenience
- ☐ Other: _____

3. SUPPORTING DATA

- ☐ Drawings, specifications, product data, performance data, test data, and any other necessary information to facilitate review of the Substitution Request is attached.
- ☐ Sample is attached. ☐ Sample will be sent if requested.

4. QUALITY COMPARISON

Provide all necessary side-by-side comparative data as required to facilitate review of Substitution Request:

SPECIFIED PRODUCT	PROPOSED PRODUCT
Manufacturer: _____	_____
Name / Brand: _____	_____
Catalog No.: _____	_____
Vendor: _____	_____
Variations: _____	_____

(Add Additional Sheets If Necessary)

Local Distributor or Supplier: _____

Maintenance Service Available: ☐ Yes ☐ No

Spare Parts Source: _____

Warranty: ☐ Yes ☐ No _____ Years**5. PREVIOUS INSTALLATIONS**

Identification of at least three similar projects on which proposed substitution was used:

PROJECT #1:

Project: _____

Address: _____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

PROJECT #2:

Project: _____

Address: _____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

6. EFFECT OF SUBSTITUTIONProposed substitution affects other work or trades: ☐ No ☐ Yes (if yes, explain)_____

Proposed substitution requires dimensional revisions or redesign of architectural, structural, M-E-P, life safety, or other work:

☐ No ☐ Yes (if yes, attach data explaining revisions)

7. STATEMENT OF CONFORMANCE OF REQUEST TO CONTRACT REQUIREMENTS

Contractor and Subcontractor have investigated the proposed substitution and hereby represent that:

- A. They have personally investigated the proposed substitution and believe that it is equal to or superior in all respects to specified product, except as stated above;
- B. The proposed substitution is in compliance with applicable codes and ordinances;
- C. The proposed substitution will provide same warranty as specified for specified product;
- D. They will coordinate the incorporation of the proposed substitution into the Work, and will include modifications to the Work as required to fully integrate the substitution;
- E. They have included complete cost data and implications of the substitution (attached);
- F. They will pay any redesign fees incurred by the Architect or any of the Architect's consultants, and any special inspection costs incurred by the Owner, caused by the use of this product;
- G. They waive all future claims for added cost or time to the Contract related to the substitution, or that become known after substitution is accepted.
- H. The Architect's approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered and Addendum is issued; and that Architect's approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed.

Contractor: _____
(Name of Contractor)

Date: _____ By: _____

Subcontractor: _____
(Name of Subcontractor)

Date: _____ By: _____

Note: Unresponsive or incomplete requests will be rejected and returned without review.

8. ARCHITECT'S REVIEW AND ACTION

- ☐ Substitution is accepted.
- ☐ Substitution is accepted, with the following comments: _____

- ☐ Resubmit Substitution Request:
 - ☐ Provide more information in the following areas: _____

 - ☐ Provide proposal indicating amount of savings / credit to Owner
 - ☐ Bidding Contractor shall sign Bidder's Statement of Conformance

- ☐ Bidding Subcontractor shall sign Bidder's Statement of Conformance
- ☐ Substitution is not accepted:
 - ☐ Substitution Request received too late.
 - ☐ Substitution Request received directly from subcontractor or supplier.
 - ☐ Substitution Request not submitted in accordance with requirements.
 - ☐ Substitution Request Form is not properly executed.
 - ☐ Substitution Request does not indicate what item is being proposed.
 - ☐ Insufficient information submitted to facilitate proper evaluation.
 - ☐ Proposed product does not appear to comply with specified requirements.
 - ☐ Proposed product will require substantial revisions to Contract Documents.

By: _____

Date: _____

Architect has relied upon the information provided by the Contractor, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall provide the specified product.

9. OWNER'S REVIEW AND ACTION

- ☐ Substitution is accepted; Architect to prepare Change Order.
- ☐ Substitution is not accepted.
- ☐ Owner will pay Architect directly for redesign fees.
- ☐ Include Architect's Additional Service fee for implementing the substitution in the Change Order.

By: _____

Date: _____
(Owner's Representative)

END OF FORM

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES**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 handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail." or other forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail." or other form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 01 21 00 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 01 22 00 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 or other form acceptable to Architect.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. ConstructionChange Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the ConstructionChange Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION (Not Used)****END OF SECTION 01 26 00**

SECTION 01 29 00 - PAYMENT PROCEDURES**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 necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703 .
 - 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 - 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - a. Include separate line items under Contractor and principal subcontracts for [Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 - 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

6. 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. If required, include evidence of insurance.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Schedule of unit prices.
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Performance and payment bonds.
 15. Data needed to acquire Owner's insurance.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION**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 provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project Web site.
 - 5. Project meetings.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.
- B. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, [on Project Web site,]and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.
- 1.6 COORDINATION DRAWINGS / BUILDING INFORMATION MODEL (BIM)
- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.

- b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 - 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
 - A. Coordination Drawing Process: Prepare coordination drawings in the following manner:
 - 1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 - 2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
 - 3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
 - 4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 - 5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 - 6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
 - 7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
 - B. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 - 2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 - 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Refer to Section 01 10 00 "Summary" for digital data software program.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.
- 1.7 REQUESTS FOR INFORMATION (RFIs)
 - A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Submit RFIs as PDF electronic files.
 - 2. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 - 3. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
 - B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.

4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- 1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES
- A. Architect's Data Files Not Available: Architect will not provide Architect's BIM model digital data files for Contractor's use during construction.
- B. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.

2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Autodesk Revit.
4. Contractor shall execute a data licensing agreement in the form from the Architect.
 - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of from the Architect.

1.9 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Critical work sequencing and long-lead items.
 - c. Designation of key personnel and their duties.
 - d. Lines of communications.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Sustainability design requirements.
 - l. Preparation of record documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Responsibility for temporary facilities and controls.
 - p. Procedures for moisture and mold control.
 - q. Procedures for disruptions and shutdowns.
 - r. Construction waste management and recycling.
 - s. Parking availability.
 - t. Office, work, and storage areas.
 - u. Equipment deliveries and priorities.
 - v. First aid.
 - w. Security.
 - x. Progress cleaning.
 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect [, and Owner's Commissioning Authority] of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.

- d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainability design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for completing sustainable design documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
 - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at regular intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site utilization.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at biweekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.

- 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION**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 documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's construction schedule.
 - 2. Construction schedule updating reports.
 - 3. Daily construction reports.
 - 4. Material location reports.
 - 5. Site condition reports.
 - 6. Special reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.
- D. Daily Construction Reports: Submit at weekly intervals.
- E. Material Location Reports: Submit at monthly intervals.

- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Special Reports: Submit at time of unusual event.
- H. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Review delivery dates for Owner-furnished products.
 - 4. Review schedule for work of Owner's separate contracts.
 - 5. Review submittal requirements and procedures.
 - 6. Review time required for review of submittals and resubmittals.
 - 7. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 8. Review time required for Project closeout and Owner startup procedures.
 - 9. Review and finalize list of construction activities to be included in schedule.
 - 10. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.

2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Seasonal variations.
 4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 5. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion, and the following interim milestones:
1. Temporary enclosure and space conditioning.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
1. See Section 01 29 00 "Payment Procedures" for cost reporting and payment procedures.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)
- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

- C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and commissioning.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).

- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.

2.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (see special reports).
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.

1.3 INFORMATIONAL SUBMITTALS

- A. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Digital Camera: Minimum sensor resolution of 20 megapixels.
 - 2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 - 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.4 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS**2.1 PHOTOGRAPHIC MEDIA**

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 20 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 - EXECUTION**3.1 CONSTRUCTION PHOTOGRAPHS**

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.

2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.
1. Flag construction limits before taking construction photographs.
 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take 20 photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
1. Do not include date stamp.

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES**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 requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 - 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 2. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 3. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals. Submittals received after 1:00 pm will be considered to have been received the following day.
1. Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Large Submittal Review: Allow 20 business days for large or complex submittal packages (e.g. Millwork, Curtainwall, Structural Steel, Door Frames and Hardware)
- C. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. Naming Convention: File name shall use the following format:
 - 1) [Specification section] – [Package number] – [Revision number] [Brief description]
 - 2) 061000-01-00 Rough Carpentry.pdf
 - b. For large Campus type projects with multiple buildings, add a Building ID after the revision identifier as follows:
 - 1) 061000-01-00 (BLDG 1) Rough Carpentry.pdf
 - c. Return Submittals: Submittals returned from Kirksey to have 'k' after the revision number, as follows:
 - 1) 061000-01-00 k Rough Carpentry.pdf
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Related physical samples submitted directly.
 - m. Indication of full or partial submittal.
 - n. Transmittal number, numbered consecutively.
 - o. Submittal and transmittal distribution record.
 - p. Other necessary identification.
 - q. Remarks.
 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.

- d. Product name.
- D. Options: Identify options requiring selection by Architect.
- E. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- F. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit submittals as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before or concurrent with Samples.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.

- g. Seal and signature of professional engineer if specified.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 - 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit one set of Samples.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.
 - 4. Location within room or space.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."

- K. Maintenance Data: Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."
- L. Sustainable Submittals: Comply with requirements specified in Section 18113.02 – Sustainable Design Requirements
- M. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- N. Insert definition of Contractor certificates here if required by individual Specification Sections. See Evaluations.
- O. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- P. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- Q. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- R. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- S. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- T. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- U. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- V. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- W. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- X. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
 - 2. Delegated design shall be performed and sealed by design professionals currently licensed within the state consistent with the project location, or as otherwise authorized by the authorities having jurisdiction.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 77 00 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.
- F. The Architect stamps each submittal with an action stamp and marks the stamp appropriately to indicate action, as follows:
 - 1. Reviewed: No resubmittal required. Final unrestricted release. When the Architect marks a submittal "Reviewed," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents.
 - 2. Furnish as Corrected: No resubmittal required. Final-but-restrictive release. When the Architect marks a submittal "Furnish as Corrected," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents.
 - 3. Revise and Resubmit: Resubmittal required. When the Architect marks a submittal "Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay.

4. Rejected: Resubmittal required. When the Architect marks a submittal "Rejected," the submittals does not have Contractor's stamp, or does not match Contract Documents.
5. No Action Taken: No resubmittal required. Filed for record only. When the Architect marks a submittal "No Action Taken," the submittal is either informational or not required per the contract documents and is filed as a record only.
6. Partial Re-submittal: Resubmittal required. Individual portions of a submittal are noted (Reviewed / Furnish as Corrected) and others are noted (Revise and Resubmit). Partial Re-submittal allows Architect to mark individual components to allow GC to proceed. Portions of the submittal that are not marked for release should be resubmitted for review.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS**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 quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
 - 1. Mockups are used for one or more of the following:
 - a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 - 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 - 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data : For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- A. Reports: Prepare and submit certified written reports and documents as specified.
- B. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of commencement of construction , and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents ,including tests and inspections indicated to be performed by the Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.

6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. If other design professionals are indicated in Specification Sections, insert qualifications here.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.

- f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 1. Build mockups of size indicated.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
 8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 10. Demolish and remove mockups when directed unless otherwise indicated.
- 1.10 QUALITY CONTROL
- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
 - B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
 - C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."
 - D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 - 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency and/or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 - 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 TEST AND INSPECTION LOG**

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES**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 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**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 requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.]
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste handling procedures.
 - 5. Other dust-control measures.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide galvanized-steel bases for supporting posts.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- D. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
 - 3. Drinking water and private toilet.
 - 4. Coffee machine and supplies.
 - 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 - 6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 77 00 "Closeout Procedures".
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. Install lighting for Project identification sign.

- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine in each field office.
 - b. Provide one telephone line(s) for Owner's use.
 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 31 20 00 "Earth Moving."
 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 32 12 16 "Asphalt Paving."
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Provide temporary parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touchup signs so they are legible at all times.

- H. Waste Disposal Facilities: Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 01 10 00 "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings. Refer to additional requirements as indicated in Section – Erosion and Sedimentation Control. .
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion. Refer to additional requirements as indicated in Section – Temporary Tree and Plant Protection.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

- K. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.
 - 1. Construct covered walkways using scaffold or shoring framing.
 - 2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 - 3. Paint and maintain appearance of walkway for duration of the Work.
- L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- M. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 - 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 3. Insulate partitions to control noise transmission to occupied areas.
 - 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 5. Protect air-handling equipment.
 - 6. Provide walk-off mats at each entrance through temporary partition.
- N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard, replace, or clean stored or installed material that begins to grow mold.

7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Consider inserting specific removal requirements, as illustrated in first subparagraph below.
 3. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 4. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 57 20 - INDOOR AIR QUALITY PLAN DURING CONSTRUCTION**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Requirements to develop and utilize an indoor air quality plan for construction and preoccupancy.
 - 2. A sample plan applicable to all interior construction and trades.

1.2 TRAINING

- A. Contractor shall provide copies of the plan and training to all subcontractors and appropriate personnel.

PART 2 - PRODUCTS (NOT USED)**PART 3 - EXECUTION****3.1 EXECUTION**

- A. Utilize a plan to protect the indoor environments from contamination during construction and preoccupancy similar to the following plan.
- B. Enforce and verify compliance by personnel and subcontractors.
- C. Photograph the related construction operations to verify conformance to each section of the plan. Provide photographs to the Architect. Submit a minimum of 18 photographs, (six taken on three separate occasions). Each set of photos shall be date stamped, highlighting the indoor air protection measures listed in paragraph 3.2A1a-e below.

3.2 INDOOR AIR QUALITY PLAN DURING CONSTRUCTION OPERATIONS

- A. Introduction
 - 1. This plan outlines the processes required to assure acceptable air quality. Elements of the program include:
 - a. HVAC Protection and Containing the work area,
 - b. Source Control and Modifying HVAC Operation and Reducing Emissions,
 - c. Pathway Interruptions,
 - d. Intensifying Housekeeping, and
 - e. Scheduling or Relocation of Occupants.

3.3 INDOOR AIR QUALITY REQUIREMENTS

- A. General: These requirements apply to all parties involved in Design, Construction, and building move in.
- B. Contaminants
 - 1. Air contaminants include many different materials. These may include; gases, vapors, chemicals, mold/fungus, pathogens, allergens, particulates and radiation. Eliminating all of these is not possible but reducing the introduction and distribution of these contaminants is possible and desirable. The programs outlined in the following pages is intended to reduce contaminants and provide as clean a building as possible for the residents.
 - 2. The following sections outline procedures and precautions to reduce building contamination and meet the requirements for a healthy environment.
- C. Construction Operations
 - 1. HVAC Protection: The air conditioning system is the distribution method for air and potentially contaminants throughout the building. Keeping the system clean is a necessity.
 - a. All air handling equipment, spiral and fabricated ducts and accessories shall be kept clean during transportation, storage and assembly. All equipment, ductwork, and accessories stored on- site shall be raised off of the floor on pallets.

- b. All lined, spiral and assembled ducts shall be wrapped and protected from dirt and water during transportation and storage. All equipment, ductwork, and accessories stored on site shall be raised off of the floor or ground on pallets.
 - c. All insulation and lined duct shall be kept dry at all times. Any insulation that has become wet shall be removed and replaced.
 - d. Fiberglass duct board in the air handlers and bases shall be kept dry and clean. Exposed fiberglass subject to erosion shall be coated with a sealer to prevent the entry of raw fiberglass into the air stream.
 - 1) Water will not be allowed to stand on any mechanical equipment.
 - e. All open ends of installed duct and equipment shall be covered and sealed to prevent the entry of dirt.
 - f. All zone boxes shall be wrapped and sealed from dirt and water before installation. Installed zone boxes shall have the openings sealed until permanently connected to the ductwork.
 - g. All dampers and attenuators into open chases and ducts shall be covered to reduce dirt entry.
 - h. The air handlers shall not be started without filtration media with a minimum efficiency reporting value (MERV) of 8, as determined by ASHRAE 52.2-2007, with errata (or equivalent filtration media class of F5 or higher, as defined by CEN Standard EN 779-2002, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance) installed at each return air grille and return or transfer duct inlet opening such that there is no bypass around the filtration media. These filters must be monitored and changed as necessary to prevent the entry of dirt into the system. The temporary media shall be removed after building flush out and before occupancy.
 - i. The return air system should not be used during sheet rock installation, sanding or painting operations.
 - j. The building should be kept under a positive pressure as much as possible.
 - k. Chase dampers shall be kept closed until the system is activated.
 - l. Complete the initial mechanical checklists at system startup.
 - m. Replace final filters with new filters before flush out or occupancy per design requirements.
2. Source Control
- a. No smoking or tobacco materials shall be allowed in the building and within 25 feet of the building entrance during construction.
 - b. No gasoline or fuel fired equipment shall be used inside any enclosed building.
 - c. Wet processes within the building shall be kept to a minimum.
 - d. All chase and wallboard materials shall be protected from water. All damaged materials shall be removed and replaced.
 - e. Use low emission materials and chemicals.
 - f. All cleaning involving chemicals shall be performed outside the building wherever possible.
 - g. All carpet materials shall be unrolled or unboxed and aired out in a well-ventilated warehouse for a minimum of three days before installation unless the carpet meets the requirements of The Carpet and Rug Institute (CRI) Green label Plus program and the cushion meets the requirements of The Carpet and Rug Institute (CRI) Green label program. Carpet and cushion should be installed a minimum of three days prior to conducting indoor air quality testing carpet materials shall be unrolled or unboxed and aired out in a well-ventilated warehouse for a minimum of three days before installation.
 - h. All modular furniture shall be aired out in a well-ventilated warehouse for seven days before entry into the building unless the modular furniture is Greenguard certified.
 - i. Trash shall be cleaned up and removed daily to the appropriate recycle container.
 - j. Any mold growth shall be treated according to the procedures shown in the New York City Department of Health "Guidelines on Assessment and Remediation of Fungi in Indoor Environments.
 - k. Clean the inside of all walls at the base track to remove excess materials and dirt with a vacuum cleaner before enclosing the wall. This is particularly critical on walls with plumbing or water piping included.
 - l. HEPA vacuum all concrete floors before installation of floor covering materials.
 - m. No obvious mold or chemical contamination shall be enclosed, hidden or painted.
3. Pathway Interruption
- a. Dust producing operations shall be exhausted to the outside to the extent possible.
 - b. Exhaust fans may be installed on each floor to remove dust and contaminants.
 - c. The air handler shall supply conditioned air to the floors. Floors with heavy dust or chemical operations shall be exhausted to the outside.

- d. During rain or high humidity conditions, the air supply coming from the coils shall be cooled to 55 degrees F or the air handler stopped to prevent moist air entry into the building. Exhaust fans shall not draw moist air into the building. It is preferable to have little airflow to moist air entering the building.
 - e. Return air dampers and openings shall be covered with filter media during operations that may contaminate the system.
- 4. Housekeeping
 - a. Food or food residues shall be properly disposed after meals or breaks.
 - b. Once the building is enclosed with finishes applied, keep dirt entry to a minimum with walk off mats at all entrances. Clean the mats at least daily.
 - c. All sweeping shall be done with dust reducing wax-based sweeping compounds.
 - d. All materials shall be kept clean and stored neatly on dunnage or pallets as required by the manufacturer.
 - e. Coils, fans, and air handler chambers including return air chambers shall be inspected and cleaned if required before start up, final testing and commissioning, and air testing.
 - f. All workers shall utilize the proper personal protective equipment per OSHA standards during any operation involving chemicals and dust production.
 - g. No food, drink, or smoking shall be allowed within the building after the building is enclosed.
- 5. Scheduling
 - a. Complete all dust producing and chemical operations before the installation of "sink" materials such as carpet and ceiling tile.
 - b. Complete the HVAC control system sufficient to allow the operation of the supply and exhaust systems to control pressurization and contaminants.
 - c. Group contaminating operations where possible to maximize exhaust use.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS**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 selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.
 - 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS**2.1 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. Products of other manufacturers that meet the specified requirements, and are sufficiently equivalent to the Basis of Design in aesthetic appearance (design, configuration, color, pattern, texture, sheen, finish etc.) to satisfy the design intent of the Architect, may be submitted for consideration as substitution requests in accordance with Section 01 25 00 Substitution Procedures. The Architect will be the sole judge of aesthetic equivalence.
 6. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 7. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- C. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION**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 general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Certified Surveys: Submit two copies signed by land surveyor.
- C. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Fire-detection and -alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.

- k. Operating systems of special construction.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Cutting and Patching Conference: Before proceeding, meet at 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.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Delete "Recording" Subparagraph below if Owner will record survey.
 3. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 77 00 - CLOSEOUT PROCEDURES**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 contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.

- a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 5. Submit test/adjust/balance records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 - C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
 6. Advise Owner of changeover in heat and other utilities.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
 - D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.
- 1.7 FINAL COMPLETION PROCEDURES
- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 1. Submit a final Application for Payment according to Section 01 29 00 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
 - B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first [and proceeding from lowest floor to highest floor].
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.
 - b. PDF electronic file. Architect will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

- g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA**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 preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS**2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY**

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.

2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
 - a. Avoid placing loose, oversize drawings in binder pockets. Use reduced drawings or place folded drawings in labeled envelopes bound in manual.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.

- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Section 01 78 39 "Project Record Documents."
- G. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit record digital data files and one set(s) of plots.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit record digital data files.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS**2.1 AS-CONSTRUCTED RECORD DRAWINGS**

- A. As-constructed record drawings, commonly referred to as "as-builts". Provide drawings that reflect the record of the building project as constructed.
- B. As-Constructed Record Prints: Maintain one set of marked-up Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.

- d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- C. As Constructed Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 01 33 00 "Submittal Procedures" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- D. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
 1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- E. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file[with comment function enabled].
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.

- e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. If possible, a Change Order proposal should include resubmitting updated Product Data. This eliminates the need to mark up the previous submittal.
 4. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.
1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked-up miscellaneous record submittals.
1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING**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 instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS**2.1 INSTRUCTION PROGRAM**

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
 - 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
 - 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
 - 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.

- g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 79 00

SECTION 01 81 13.02 - SUSTAINABLE DESIGN REQUIREMENTS**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 general requirements and procedures for compliance with Architect's sustainable design and construction requirements
- B. Related Sections:
1. Divisions 01 through 33 Sections for requirements specific to the work of each of these Sections.
 2. Division 01 Section "Construction Waste Management."
 3. Division 01 Section "Indoor Air Quality During Construction."

1.3 SUBMITTALS

- A. Provide Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal" .

PART 2 - PRODUCTS**2.1 LOW-EMITTING MATERIALS**

- A. For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to South Coast Air Quality Management District (SCAQMD), Rule No. 1168, effective date July 1, 2005 and rule amendment date January 7, 2005.

- 2.2 See SCAQMD Rule 1168 effective July 1, 2005 and Green Seal Standards GS-11 and GS-03 for items not listed:

Adhesives	VOC Limit (g/L)	Adhesives	VOC Limit (g/L)
Carpet and Carpet Pad Adhesive	50	Special Purpose Contact Adhesive (vinyl wallcovering, wood veneer, melamine)	250
Wood Floor Adhesive	100	Structural Glazing Adhesive	100
Rubber Floor Adhesive	60	Multipurpose Construction Adhesive	70
VCT Adhesive	50	Cove Base Adhesive	50
Ceramic Tile Adhesive	65	Drywall and Panel Adhesive	50
Metal to Metal Adhesive	30	Porous Material Adhesive (except wood)	50
Sealants		Sealant Primer	
Architectural Sealant (includes duct and plumbing sealant)	250	Architectural, non-porous	250
		Architectural, porous	775
Paints		Coatings	
Flat Paints and Primers	50	Clear Wood Finishes	350
Non-flat Paints and Primers	150	Concrete Curing Compound	350
Anti-Corrosive/Anti-Rust Paint	250	Fire Retardant Coating- Pigmented	350
Sealers and Undercoaters	200	Floor Coatings	100

		Waterproofing Sealers	250
		Waterproofing Concrete, Masonry Sealers	400

- 2.3 For field applications that are inside the weatherproofing system, use aerosol adhesives that comply with the following limits for VOC content when calculated according to Green Seal Standard for Commercial Adhesives GS-36 effective October 19, 2000.
- A. For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to Green Seal Standard GS-11, Paints, First Edition May 20, 1993, Green Seal Standard GC-03, Anti-Corrosive Paints Second Edition, January 7, 1997, and South Coast Air Quality Management District (SCAQMD), Rule No. 1113, Architectural Coatings, in effect on January 1, 2004
 - B. CRI Green Label Plus Certification: Use CRI Green Label Plus-certified carpet and carpeting adhesives with VOC content of less than 50 g/L. An acceptable alternative to CRI Green Label Plus certified carpet is the use of carpeting that meets 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, including 2004 Addenda.
 - C. Urea Formaldehyde Prohibition: Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.
 - D. FloorScore Certification: Use FloorScore-certified hard surface flooring. An acceptable alternative to FloorScore certified flooring is the use of flooring that meets 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, including 2004 Addenda.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

- A. Comply with Division 01 Section "Construction Waste Management and Disposal."

3.2 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Comply with Division 01 Section "Indoor Air Quality Plan During Construction."
 - 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.

END OF SECTION

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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and, for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Predemolition Photographs or Video: Submit before Work begins.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural 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.
 - 1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
 - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - c. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- B. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

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.
 - 1. Comply with requirements for access and protection specified in Section 01 50 00 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- 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 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.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.5 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

SECTION 03 30 00 - CAST IN PLACE CONCRETE**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings, Bidding Requirements, Contract Forms, and Conditions of the Contract apply to the work of this section.

1.2 DESCRIPTION OF THE WORK

- A. Furnish all labor, materials, tools, equipment, and related items required to provide cast-in-place concrete consisting of Portland cement, fine and coarse aggregate, water and selected admixtures; combined, mixed, transported, placed, finished and cured as herein specified.
- B. Related work specified in other sections:
 - 1. Portland Cement Concrete Pavement - Section 32 13 13
 - 2. Concrete Formwork - Section 03 10 00
 - 3. Concrete Reinforcement - Section 03 20 00

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ACI 301, Specifications for Structural Concrete for Buildings.
 - 2. ASTM C33, Standard Specifications for Concrete Aggregate.
 - 3. ASTM C94, Standard Specifications for Ready-Mix Concrete.
 - 4. ASTM C150, Standard Specifications for Portland Cement.
 - 5. ASTM C260, Standard Specifications for Air-Entraining Admixtures for Concrete.
 - 6. ASTM C494, Standard Specifications for Chemical Admixtures for Concrete.
- B. Concrete Mix Design: Contractor shall employ and pay cost of a recognized independent Testing Laboratory to perform the following services:
 - 1. Design concrete mixes in accordance with ACI 301.
 - 2. For each concrete mix type proposed, make a trial mix using aggregate proposed.
 - 3. Determination of required average strength above specified strength shall be in accordance with ACI 301.
 - 4. Make advance tests of trial mixes with proposed materials. Mold and cure in accordance with ASTM C31; test cylinders in accordance with ASTM C-39. Do not place concrete on project until laboratory reports and breaks of confirmation cylinders indicate that proposed mixes will develop required strengths.
 - 5. Submit proposed mix designs to Architect for review min. 14 days prior to placing concrete. Show:
 - a. Proportions of cement, fine and coarse aggregates, and water.
 - b. Combined aggregate gradation.
 - c. Aggregate specific gravities and gradations.
 - d. Water-cement ratio, design strength, slump, and air content.
 - e. Type of cement and aggregates.
 - f. Type of dosage of admixtures.
 - g. Type, color and dosage of integral coloring compounds, where applicable.
 - h. Special requirements for pumping.
 - i. Range of ambient temperature and humidity for which design is valid.
 - j. Any special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product.
 - 6. Mix designs based on a record of past performance in accordance with ACI 301, method 2, may be submitted in lieu of mix designs required above, provided all necessary information is included.
 - 7. Check mix designs and revise if necessary wherever changes are made in aggregates or in surface water content of aggregate or workability of concrete. Slump shall be minimum to produce workable mix. The laboratory shall prescribe the maximum quantity of water.

- C. Test Cylinders: Make at least one (1) test of each day's pouring or each fifty (50) cu. yards, whichever comes first on each different portion or section of the work. Mold and cure specimens in accordance with ASTM C31, and test in accordance with ASTM C39. Test cylinders shall be made and tested by the laboratory. Footing, walls, and floor systems constitute different sections. Each test shall consist of five (5) specimens: two (2) to be tested at twenty-eight (28) days, two (2) to be tested at seven days, and one held in reserve. Determine temperature and air content for each set of test cylinders in accordance with ASTM C231.
- D. Field Quality Control:
 - 1. Determine slump for each strength test and whenever consistency of concrete appears to vary, in accordance with ASTM C143.
 - 2. Monitor addition of water to concrete and length of time concrete is allowed to remain in truck.
 - 3. Certify delivery tickets indicating class of concrete, amount of water added during initial batching, and time initial batching occurred.
 - 4. Monitor work being performed in accordance with ACI (American Concrete Institute) recommendations as a standard of quality.
- E. Source Quality Control: Periodically inspect and control concrete mixing and loading of transit mix trucks at batch plant at intervals as agreed by Architect and laboratory personnel.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Mix and deliver concrete to project ready-mixed in accordance with ASTM C94. Mix concrete min. 70 revolutions of transit mix drum at mixing speed. Min. 40 revolutions shall be at the production plant.
- B. Schedule delivery so that continuity of any pour will not be interrupted for over 15 minutes.
- C. Place concrete on site within 90 minutes after proportioning materials at batch plant.

1.5 JOB CONDITIONS

- A. Weather Requirements:
 - 1. Hot Weather Concreting:
 - a. Follow ACI 301.
 - b. Provide retarding type admixture conforming to ASTM C494-Type A or D in accordance with manufacturer's recommendations.
 - 2. Cold Weather Concreting:
 - a. Follow ACI 301.
 - b. When ambient temperature at site is below 40 degrees F or is expected to fall to that temperature within ensuing 24 hours, heat water and/or aggregates prior to adding to mix so that temperature of concrete will be between 60 degrees F and 90 degrees F at time of placement.
 - c. Maintain temperature of deposited concrete between 50 degrees F and 70 degrees F for min. 7 days after placing.
 - 3. Temperature Changes: Maintain changes in concrete temperature as uniform as possible, but in no case exceed change of 5 degrees per hour or 25 degrees in any 25-hour period.
 - 4. Admixture intended to accelerate hardening of concrete or produce higher than normal strength at early periods will not be permitted unless specified or prior approval is obtained from Architect.

1.6 SUBMITTALS

- A. Concrete Mix Design.

- B. Delivery Tickets: Furnish duplicate delivery tickets for each load of ready-mix concrete delivered to site, in accordance with ASTM C94. Show batch weights on each ticket.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Portland Cement: ASTM C-150, Type I. Type III may be used for cold weather concreting when approved by Architect.
- B. Aggregate:
1. Fine: ASTM C-33, clean hard, durable, uncoated, natural non-staining sand free from silt, loam or clay.
 2. Coarse: ASTM C-33, hard, durable, uncoated, crushed stone, gradation in accordance with size No.57, unless otherwise approved in mix design. Max. aggregate size in accordance with ACI 318.
- C. Water: Clean and free from oil, acid and injurious amounts of vegetable matter, alkalies and other impurities.
- D. Admixtures:
1. Water-reducing or water-reducing/set-retarding; ASTM C494.
 2. Air entraining agent: ASTM C260.
- E. Curing Materials:
1. Waterproof Paper: FS UU-P-265a.
 2. Polyethylene Sheeting: Minimum 0.004" thick, free from defects, uniform in appearance, white.
 3. Curing Compounds: L&M "CURE" by L & M Construction Chemicals, Inc., or approved equal, for interior concrete slab surfaces. Curing compounds must be compatible with floor hardener and sealer.
- F. Liquid Floor Hardener and Sealer: "Lapidolith" as manufactured by Sonneborn Building Products or approved equal.
- G. Expansion Joint Filler: ASTM D1752, Type 1, non-asphaltic.
- H. Non-shrinking Cement Grout: U.S. GrouT Corp. "Five Star Grout" or equal.
- I. Non-Slip Stair Nosing: Equal to Wooster No. 101 "Alumograt" of required length.

2.2 MIXES

- A. Strength: Concrete is classified and specified by ultimate compressive strength (f'_c) at age 28 days.
- B. Proportions: Proportions of cement, aggregate, and water to attain required plasticity and compressive strength shall be in accordance with ACI 318. Do not make changes in proportions without the Architect's approval.
- C. Design concrete to yield the following 28-day characteristics:
- | Type | Compressive Strength | Cement Type | Cement Content | Slump Limits Min./Max. |
|------|----------------------|-------------|----------------|------------------------|
| I | 3000 psi | Portland | 5* | 3"/5" |
| II | 4000 psi | Portland. | 6 | 3"/5" |
- * bags per cu. yd.
- D. Concrete Uses: Refer to structural drawings for type usage.
- E. Concrete permanently exposed to weather: Contain air-entraining admixture to produce 5% +/- 1% air by volume of concrete.

- F. Maximum Fly Ash Rice Hull Ash, or other pozzolanic materials (see credit resections for Fly Ash), content shall be 25% by weight.
1. Fly ash generated from municipal solid waste incinerators is not an acceptable recycled content material under this criterion, nor is fly ash generated as a coal combustion by product where the coal plant is fired with hazardous waste, medical waste or tire derived fuel. Mercury concentration should not be more than 5.5 ppb (0.00055 mg/L) as determined by a Toxic Characteristic Leaching Procedure (TCLP) following EPA 7470A.
 2. Provide data sheet submittals to design team verifying recycling material content and quantities.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Notify Architect and Testing Laboratory at least 24 hours prior to when each concrete operation is to begin.
- B. Allow various trades ample time to install anchor bolts, sleeves, conduit and inserts necessary for proper execution of their work. Accurate position in form. Do not cut reinforcing steel to facilitate installation of inserts or accessories.
- C. If power screeds are to be used, recess sleeves and cap in manner to prevent water and cement from entering, but so that they may be located after finishing. Otherwise, extend sleeves 1" above the finish floor.
- D. Remove impounded water from forms and excavations before concrete is deposited. Close temporary drains by grouting or by other satisfactory means. Close openings left in forms for cleaning and inspection, after forms have been cleaned out, inspected and approved.
- E. Remove debris from space to be occupied by concrete before concrete is deposited. Before beginning placement, remove hardened concrete and foreign substances from inner surface of mixing and conveying equipment.
- F. Provide runways, pumps, conveyors, etc. to convey concrete to the point of deposit in order not to disturb forms or reinforcement or segregate concrete. Do not allow conveying equipment directly over reinforcement.
- G. Do not allow concrete to free-fall over 5'-0"; provide tremies, chutes or other approved means of conveyance when drop exceeds this amount.

3.2 INSTALLATION

- A. Placing: Place concrete in accordance with requirements of ACI 301 and as modified herein. Direct concrete rapidly from mixer to forms and deposit as nearly as possible in its final position to avoid segregation due to rehandling or flowing. Do not place partially hardened, contaminated, or retempered concrete.
- B. Consolidation: Place concrete with aid of mechanical vibrating equipment unless otherwise approved by Architect. Apply vibration at point of deposit and in area of freshly placed concrete. Vibrate enough to accomplish thorough compaction and complete embedment of reinforcement and fixtures. Supplement vibration by hand-spading in corners and angles of forms to prevent honeycombing.
- C. Bonding: Before depositing new concrete on concrete that has set, roughened, and clean surface of set concrete of laitance, foreign matter and loose particles. Wet surface of set concrete just prior to placing new concrete.
- D. Protection and Curing:
1. Protect concrete from frost damage and moisture loss.
 2. Provide artificial heat to maintain the temperature of concrete above minimum required herein for duration of curing period.
 3. Keep forms sufficiently wet to prevent cracking of concrete or loosening of form joints.

4. Cure surfaces of exposed concrete by means of curing compound or sheeting method, as applicable.
- E. Patching Formed Surfaces of Exposed Concrete:
1. After forms have been removed, inspect concrete surfaces and patch pour joints, voids, stone pockets, other defective areas, and tie holes before concrete is thoroughly dry. Chip away defective areas to a depth of not less than 1" with edges perpendicular to surface. Wet areas to be patched and spaced at least 6" wide surrounding it, to prevent absorption of water from patching mortar. Do not patch concrete in freezing weather.
 2. Apply chemical bonding agent to surface in accordance with manufacturer's recommendations, followed immediately by patching mortar. Make patch of same proportions as used for concrete except omit coarse aggregate. Add only enough water consistent with requirements for handling and placing.
 3. Thoroughly compact mortar into place and screed off; leave patch slightly higher than surrounding surface. Leave undisturbed for one to two hours to permit initial shrinkage before final finishing. Finish patch to match texture and color of adjoining surface. Completely fill tie holes left by withdrawal of rods and holes left by removal of end of ties. For holes passing entirely through wall, force mortar through with plunger type grease gun. Cure all patches.
- F. Finishing Formed Surfaces:
1. As - Formed Finish.
 - a. Provide at surfaces not exposed to view in completed work.
 - b. Remove fins by stoning, otherwise leave texture imparted by forms.
 2. Rubbed Finish:
 - a. Provide exterior vertical surfaces exposed to view in completed work.
 - b. After removal of forms, patching and repairing, and while concrete is still green, spread slurry consisting of 1-part Portland cement and 1-1/1-part damp, loose sand by volume, over pre-dampened surface. Apply using burlap pads or sponge rubber floats. Remove surplus materials, then rub with clean burlap. Water for completed surfaces for 7 days min.
- G. Flatwork:
1. Forms and Screeds: Set edge forms and intermediate screed strips accurately to produce designed elevations and contours in finished surfaces. Align concrete surface to contours of screed strips using strike-off templates or compacting type screeds. When formwork is cambered, set screeds to like camber to maintain proper concrete thickness.
 2. Floated Finish: Provide slab surfaces to precede other finishes. Begin floating after concrete has been struck off, consolidated, and leveled, surface water has disappeared, and surface is sufficiently hardened to support power driven float. Finish surface with impact type power driven float or hand float. Test surface with 10'-0" straightedge placed at min. 2 different angles: correct irregularities exceeding 1/4". Refloat repaired areas.
 3. Trowel Finish: Provide interior slab surfaces under carpet, vinyl composite floor tile and exposed concrete floors.
 4. Light Broom Finish: Light broom finishes under thin ceramic tile floors, ramps and steps.
- H. Liquid Floor Hardener and Sealer:
1. Apply hardener and sealer for all finished concrete floors that will be left exposed, not receiving additional finish.
 2. Apply hardener and sealer in separate coats in accordance with manufacturer's directions and using the maximum quantity recommended. Surface to be treated must be clean and dry, with all work above the floor completed before the hardener and sealer is applied. Upon completion, concrete surfaces shall be clean, without discrepancies, discoloration, or traces of excess hardener left on the surface.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Structural steel framing members, support, members.
2. Base plates, shear stud connectors.
3. Grouting under base plates.

B. Related Sections:

1. Section 01 40 00 - Quality Requirements: Independent testing agency procedures and administrative requirements.
2. Section 05 30 00 - Steel Deck: Field installation of shear connectors through deck.
3. Section 05 50 00 - Metal Fabrications: Steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.

1.2 REFERENCES

- A. AISC - LRFD Manual of Steel Construction.
- B. AISC - ASD/LRFD Steel Construction Manual.
- C. AISC - Specifications for Structural Steel Buildings.
- D. ASCE 7 - American Society of Civil Engineers - Wind Loads.
- E. ASTM A36/A36M, Standard Specification for Carbon Structural Steel.
- F. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
- G. ASTM A108 - Standard Specification for Steel Bars, Carbon, and Alloy, Cold-Finished.
- H. ASTM A123/A123M - Standard Specification for Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.
- I. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- J. ASTM A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel.
- K. ASTM A307 - Standard Specification for Carbon Steel and Studs, 60 000 PSI Tensile Strength.
- L. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- M. ASTM A449 - Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.

- N. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
- O. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- P. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- Q. ASTM A514/A514M - Standard Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
- R. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
- S. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
- T. ASTM A568/A568M - Standard Specification for Steel, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled Sheet and Cold-Rolled Sheet, General Requirements for.
- U. ASTM A992/A992M - Standard Specification for Structural Steel Building.
- V. ANSI/AWS A2.4 - Symbols for Welding, Brazing and Nondestructive Examination.
- W. AWS D1.1/D1.1M - Structural Welding Code.
- X. FM - Roof Assembly Classifications.
- Y. SSPC (Steel Structures Painting Council) - Paint Manual.
- Z. UL - Fire Resistance Directory.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a licensed professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360.
 - 2. Use ASD; data are given at service-load level.
- B. Moment Connections: Type FR, fully restrained.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. Indicate locations and dimensions of protected zones.
 - 6. Identify demand critical welds.
 - 7. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the licensed professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer, fabricator, professional engineer, testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength bolt-nut-washer assemblies.
 - 4. Shear stud connectors.

- 5. Shop primers.
- 6. Nonshrink grout.
- F. Source quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE minimum.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/ D1.1M, "Structural Welding Code - Steel."
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 341 and AISC 341s1.
 - 3. AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- E. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS**2.1 STRUCTURAL-STEEL MATERIALS**

- A. All structural steel framing shall contain a minimum of 85% recycled material consistent.
 - 1. Provide data sheets as submitted to verify recycled material content to design team.
- B. W-Shapes: ASTM A 992/A 992M.
- C. Channels, Angles, ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50.
- F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: see plans.
 - 2. Finish: Black except where indicated to be galvanized.
- G. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.
- H. Steel Forgings: ASTM A 668/A 668M.
- I. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.

- C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain.
- E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- F. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 5. Finish: Plain.
- G. Headed Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 4. Finish: Plain.
- H. Threaded Rods: ASTM A 36/A 36M.
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 2. Washers: ASTM A 36/A 36M carbon steel.
 - 3. Finish: Plain.
- I. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- J. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- K. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- L. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.

2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 ASTM A 780.

2.4 GROUT

- C. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- D. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Galvanized surfaces embedded in concrete or mortar.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
9. SSPC-SP 8, "Pickling."

- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a one-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/ D1.1M.
 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. All complete penetration (full pen) moment connections shall be ultrasonic tested.

- E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup paint.

END OF SECTION

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. Formed wall sheet metal fabrications.

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 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 expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 - 8. Include details of roof-penetration flashing.
 - 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 - 10. Include details of special conditions.
 - 11. Include details of connections to adjoining work.
 - 12. Include stamped engineering drawing for metal coping.
 - 13. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested FM Approvals approved.

1.6 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.

1.7 WARRANTY

- A. All roofing-related sheet metal, including mechanical, plumbing, and electrical flashings be constructed under the roofing contract and included within the roofing warranty.
- B. 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: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 SUSTAINABILITY REQUIREMENTS**

- A. Low Emitting Requirements: Provide product that meets low emitting criteria listed in section 01 81 13.02 – Sustainable Design Requirements.

2.2 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 NRCA's "The NRCA Roofing Manual" 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.

2.3 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 620. 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.
 - 2. Color: As selected by Architect from manufacturer's full range.
 - 3. 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.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.

2.4 UNDERLAYMENT MATERIALS

- A. Refer to High-Temperature Underlayment in section 07 62 10 – Flexible Flashing.

2.5 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, 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.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Zinc-Coated (Galvanized) 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 Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- 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 wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone 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. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.6 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.
 - 5. Where counter flashing profiles are required, provide two-piece profile so that reroofing can be performed without removal of the adjacent cladding system. Lap, rivet, and seal all counterflashing corners.
 - 6. Sheet metal flashing is required to terminate roofing in all locations, all termination bar and roofing terminations must be flashed with sheet metal including transitions between adjacent flashings at differing elevations (i.e., coping to counterflashing transitions, etc.). Contractor shall install necessary corner/transition flashings as required for continuous system. This includes cladding transitions as well.
 - 7. Fabricate cleats one gauge heavier than the flashing metal. Comply with the requirements of ANSI/SPRI ES-1 and SMACNA Architectural Sheet Metal Manual for metal thickness, joinery, and profile.
 - 8. Rivet all non-moving seams in sheet metal systems. Indicate that butyl sealant may be concealed within metal joints and silicone for exposed metal joints.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a 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.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

- D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- I. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- J. Do not use graphite pencils to mark metal surfaces.

2.7 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
 - 1. Aluminum: 20 gauge, 0.032 inch thick.
 - 2. Stainless Steel: 26 gauge, 0.0187 inch thick.

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.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 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. Torch cutting of sheet metal flashing and trim is not permitted.
 6. Do not use graphite pencils to mark metal surfaces.
 7. Provide continuous cleats, in lieu of, spacing cleats no more than 12-inches apart and that the coping/edge flashings comply with ANSI/SPRI ES-1 or follow guidelines utilized in tested assemblies. The tested assemblies in ANSI/SPRI ES-1 also have requirements for coping and cleat fastener spacing. The specified fastener spacing is generally too wide when compared to the standard tested assemblies.
- 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 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.
 3. Integrate coping underlayment with the weather barrier. Where TPO roofing is used, bring TPO membrane up and over parapet and integrate with air barrier.
- 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 wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- 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."
- 3.4 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.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.
- 3.5 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."
- 3.6 CLEANING AND PROTECTION
- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. 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.

- D. 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 62 10 - FLEXIBLE FLASHING**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. Concealed flashing within wall assemblies to protect and shed incidental water to the exterior.

1.3 QUALITY REQUIREMENTS

- A. Flexible flashing materials to be single sourced with the weather barrier system.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store flashing materials in contact with other materials that might cause staining, denting, or other surface damage. Store flashing 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 the extent necessary for the period of sheet metal flashing and trim installation.

1.1 WARRANTY

- A. Provide manufacturer's standard 5-year material warranty.

PART 2 - PRODUCTS**2.1 SUSTAINABILITY REQUIREMENTS**

- A. Low Emitting Requirements: Provide product that meets low emitting criteria listed in section 01 81 13.02 – Sustainable Design Requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Flashing and trim assemblies as indicated shall withstand structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed flashing shall not leak, or loosen, and shall remain watertight.

2.3 SELF-ADHERED FLEXIBLE SHEET FLASHING

- A. Self-Adhesive flexible flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 40 mils.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing; CCW-705 Air & Vapor Barrier Strips.
 - b. GCP Applied Technologies; Perm-A-Barrier Detail Membrane.
 - c. Henry; Blueskin SA

2.1 FLUID APPLIED FLASHING

- A. Liquid, high-performance, medium modulus, UV stable, non-sag polyurethane sealant. Using fan tip apply 40 mil sealant to rough openings. Rough opening perimeters for fenestration/window, door and curtain wall applications.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Coatings & Waterproofing.
 - b. GCP Applied Technologies.
 - c. Henry

2.2 HIGH TEMPERATURE FLASHING

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing. Provide primer according to written recommendations of underlayment manufacturer if needed.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
 - b. GCP Applied Technologies.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
 - 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, separators, sealants, and other miscellaneous items as required for complete metal flashing installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions 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.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FLASHING INSTALLATION

- A. General: Install as indicated on Drawings and per Manufacturer's recommendations.
- B. Self-Adhering Sheet Flashing: Install self-adhering sheet flashing, wrinkle free. Apply primer if required by flashing manufacturer. Comply with temperature restrictions of flashing manufacturer for installation. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover flashing with subsequent construction within 14 days.
- C. Location:
 - 1. Flexible Flashing: As indicated on drawings, or at all exterior windows, doors or other penetrations where high temperature flashing is not required.
 - 2. High Temperature Flashing: As indicated on drawings, or at all locations where flashing will be in contact with metal coping or metal panels where high temperatures exist.

END OF SECTION

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. Nonstaining silicone joint sealants.
 - 2. Mildew-resistant joint sealants.
 - 3. Butyl joint sealants.
 - 4. Latex joint sealants.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation 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. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer
- B. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- D. Field-Adhesion-Test Reports: For each sealant application tested.

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.
- C. Sealant Log: provide sealant logs

1.7 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 or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less or greater 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.

1.8 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: Urethane Sealants; Five years from date of Substantial Completion.
 - 2. Warranty Period: Silicone Sealants; Twenty years from date of Substantial Completion
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS**2.1 SUSTAINABILITY REQUIREMENTS**

- A. Low Emitting Requirements: Provide product that meets low emitting criteria listed in section 01 81 13.02 – Sustainable Design Requirements.

2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: Match adjacent substrates unless indicated otherwise.

2.3 SILICONE JOINT SEALANTS

- A. Silicone, ASTM C920, Type S, Grade NS, Class 50, Use NT, Nonstaining ASTM C 1248: single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 795.
 - b. GE Construction Sealants; SilPruf NB.
 - c. Pecora Corporation; 864NST .
 - d. Tremco Incorporated; Spectrem 2 .
 - e. Sika Corporation; Silasil WS295.
 - 1. Description: Neutral, one-part silicone sealant.
 - 2. Usage: Structural glazing, steel, anodized aluminum, glass and painted metal.

- B. Silicone, ASTM C920, Type S, Grade NS, Class 50, Use NT, Nonstaining ASTM C 124; single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 791.
 - b. GE Construction Sealants.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.
 - e. Sika Corporation.
 2. Description: Neutral, one-part silicone sealant.
 3. Usage: Steel, anodized aluminum, glass and painted metal, non-porous substrates, curtain walls, fluid-applied air barrier.
- C. Silicone, ASTM C920, Type S, Grade NS, Class 25, Use NT, Nonstaining ASTM C 1248: single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 758.
 - b. GE Construction Sealants.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.
 2. Description: Neutral one part silicone sealant, designed for adhering to low energy surfaces common in sheet or peel and stick weather resistant barriers.
 3. Usage: Typical use at self-adhering sheet membrane or flexible flashing with polyethylene surfaces.
- D. Silicone, ASTM C920, Type S, Grade NS, Class 100/50, Use NT, Nonstaining ASTM C 1248: single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Construction Sealants.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.
 2. Description: Ultra-low-modulus sealant for new and remedial construction joint sealing applications.
 3. Usage: Natural stone, concrete, cast stone, CMU, brick and metals where more significant joint movement is anticipated.
- E. Silicone, ASTM C920, Type S, Grade NS, Class 50, Use NT, Nonstaining ASTM C 1248: single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 756.
 - b. GE Construction Sealants.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.
 2. Description: Medium-modulus elastomeric sealant designed for weather-proofing sensitive porous stone and metal panel substrates. Reduced residue rundown or dirt pick up, substrate staining and adheres unprimed to porous and non-porous substrates.
 3. Usage: Alternative for natural stone, cast stone, CMU, brick masonry and metal substrates where joint movement of up to +/- 50% is anticipated.

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, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 786-M White.
 - b. GE Construction Sealants; SCS1700 Sanitary.
 - c. Tremco Incorporated; Tremsil 200.

- d. Sika Corporation; Sikasil GP.
- 2. Usage: Seal nonporous surfaces around showers, tubs, sinks and plumbing fixtures where conditions of high humidity and temperature extremes exist. Typical applications include: • Sealing around shower-tub enclosures, tubs, sinks, urinals and whirlpools • Sealing around bathroom fixtures • Waterproofing rimless sinks • Ceramic tile grouting.

2.5 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; BA-98.
 - b. Sika; SikaLastomer 511
 - 2. Usage: Concealed mastics, flashings, aluminum thresholds, sill plates.

2.6 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20.
 - b. Sherwin-Williams Company (The); 850A .
 - c. Tremco Incorporated; Tremflex 834.
 - 2. Usage: General purpose interior and exterior caulking and as a back bedding glazing compound. Use on vinyl, aluminum and wood siding as well as on bathroom and kitchen fixtures.

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Construction Chemicals, LLC, Building Systems.
 - b. Construction Foam Products, a division of Nomaco, Inc.
- B. Backer Rod: ASTM 1330. Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 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.
- D. Weep Tubes to Weep Space Between Inner and Outer Seals on Concrete Panels: Weep and Vent Tubes: Clear plastic (PVC) UV-stable reticulated tubing, minimum ¼-inch (6.35mm) inside diameter, and of length as required to extend between exterior face of sealant and open cavity behind.

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.
 - d. Exterior insulation and finish systems.
 - 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.
 - 1. Limit priming to areas that will be covered with sealant in the same day. Unless recommended otherwise by the sealant manufacturer, re-prime areas exposed for more than 24 hours.
- 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 Nonsag 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.
- 3.4 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.
- 3.5 PROTECTION
- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 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.

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 to comply with the following Steel Door Institute Performance Standards:
 - 1. Hollow metal work fabricated according to ANSI/SDI A250.8 (R2008).
 - 2. ANSI/SDI A250.4 (2001) - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
 - 3. ANSI/SDI A250.6 (R2009) - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - 4. ANSI/SDI A250.10 (R2004) - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
 - 5. ANSI/SDI A250.11 (2001) - Recommended Erection Instructions for Steel Frames.
 - 6. ANSI/SDI A250.13 (2008) – Testing and Rating of Severe windstorm Resistant Components for Swinging Door Assemblies.
 - 7. SDI 111 (2008 – Recommendations for Selection and Usage Guide for Standard Steel Doors and Frames.
 - 8. SDI 117 (2009) – Manufacturing Tolerances Standard Steel Doors and Frames.
 - 9. SDI 122 (2007) - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
 - 10. SDI 124 (1998) - Maintenance of Standard Steel Doors and Frames.

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, temperature-rise 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.

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.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames from single source manufacturer.
- B. Preinstallation Conference: Conduct conference at Project site to review anchor methods, electrical conduit connections and custom installation of unusual openings such as pocket frames, single rabbet double egress frames and recessed doors flush with walls.

1.8 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 nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal 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.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.
 - 2. Any scratches or disfigurements caused in shipping or handling are promptly cleaned and touched up with a rust-inhibitive primer.

PART 2 - PRODUCTS**2.1 SUSTAINABILITY REQUIREMENTS**

- A. Low Emitting Requirements: Provide product that meets low emitting criteria listed in section 01 81 13.02 – Sustainable Design Requirements.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following SDI members manufacturers:
 - 1. Ceco Door Products; an Assa Abloy Group company.
 - 2. Curries Company; an Assa Abloy Group company.
 - 3. Pearland Industries
 - 4. Steelcraft; an Allegion Company.
 - 5. No Substitutions: Only material from an SDI member will be allowed on the Project Site unless prior approval is given in accordance with substitution request requirements per General Requirements.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.3 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (16 gage), with minimum A60 coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - 1) Thermal-Rated Doors: Provide doors fabricated with assembly thermal-transmittance value (U-Factor) of not greater than 0.50 Btu/h-sf-F when tested according to ASTM C 1363.

3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
 - b. Construction: Full profile and throat welded.
 - c. Frames for Level 3 Steel Doors: (14 gage) thick steel sheet.
4. Exposed Finish: Factory prime, field painted. Refer to section 09 91 00 – Painting

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 1. Masonry Anchors: Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the (T-strap) (or) (stirrup) (or) (wire) type. Anchors shall be not less than 16 gage steel or 0.156" diameter steel wire. Stirrup straps shall be not less than 2" X 10" in size, corrugated and/or perforated. The number of anchors provided on each jamb shall be as follows:
 - a. Frames up to 60" height 2 anchors.
 - b. Frames greater than 60" up to 90" 3 anchors.
 - c. Frames greater than 90" up to 96" 4 anchors.
 - d. Frames greater than 96" 4 anchors plus one for each 24" or fraction thereof over 96", spaced at 24" maximum between anchors.
 2. Stud Anchors: Welded frames for installation in stud partitions shall be provided with steel anchors of suitable design, not less than 18 gage thickness, secured inside each jamb as follows:
 - a. Frames up to 60" height 2 anchors.
 - b. Frames greater than 60" up to 90" 4 anchors.
 - c. Frames greater than 90" up to 96" 5 anchors.
 - d. Frames greater than 96" 5 anchors plus one for each 24" or fraction thereof over 96" spaced at 24" maximum between anchors.
 3. Frames to be anchored to previously placed concrete, masonry or structural steel shall be provided with anchors of suitable design and quantity as shown on approved shop drawings. Fasteners for such anchors shall be provided by others.
 4. Slip on frames shall be provided with a single adjustable tension anchor in each jamb and provision for secure attachment of each jamb base to stud runners.
- 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. Monolithic Concrete Slabs: Floor anchor shall be provided with two holes for fasteners and shall be fastened inside jambs with at least four (4) spot welds per anchor
 3. Separate Topping Concrete Slabs: Adjustable- floor anchors , providing no less than 2 in. height adjustment, shall be fastened in place with at least four (4) spot welds per anchor. 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. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z 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.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

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. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow-Metal Doors:
 - 1. 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.
 - 2. Glazed Lites: Factory cut openings in doors.
 - 3. 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.
 - 4. Continuous Hinge Reinforcement: Provide continuous 12 gage strap tack welded to door edge for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware," unless door has continuous steel channel for hinge reinforcement.
 - 5. Electrical Raceways: Provide raceways to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 08 Section "Door Hardware." Provide sufficient number of concealed wires to accommodate electrical function of specified hardware. Wire nut connections are not acceptable.
 - 6. Seamless Edge: Provide seamless edge on hollow metal doors by intermittently tack welding seam, edge filled, grinding smooth and finishing edge free from defects and blemishes.
- D. 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. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Sidelight 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.
 - 3. Equal Rabbet Frames: Provide frames with equal rabbet dimensions unless glazing and removable stops require wider dimension on glass side of frame.
 - 4. High frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 42-inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
 - 5. Continuous Hinge Reinforcement: Provide continuous 12 gage strap tack welded to frame stop for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware."
 - 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 7. Provide A60 Galvannealed coating at frames in restrooms with showers/Jacuzzi, clean areas such as surgery rooms and surgical suites, clean rooms, and soil rooms.
 - 8. Electrical Knock Out Boxes: Factory weld 18 gage electrical knock out boxes to frame for electrical hardware preps; included to electrical thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnet locks as noted in door hardware sets in Division 8 Door Hardware and security prints.
 - a. Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations for all exterior locations regardless of electrical hardware specified in Division 8 Door Hardware and security prints.
 - b. Provide electrical knock out boxes with a dual 1/2-inch and 3/4-inch knockouts.
 - c. Conduit to be factory installed for electric hardware preps. Frames with factory installed conduit to have weld in place anchors.
 - d. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 8 Door Hardware and security prints.
 - e. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb, coordinate with hardware supplier
 - f. Provide conduit for standardized plug connectors to accommodate up to (12) wires for electrified door hardware specified in hardware sets in Division 08 Section "Door Hardware" and security prints.
 - 9. 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.

10. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. 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.
 - c. Compression Type: Not less than two anchors in each frame.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 11. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware."
 - 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.
 12. Cut-Off (Sanitary) Stops: Where indicated on Door Schedule/Frame Type, terminate stops 4 inches above finish floor with a 45 -degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- E. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- F. 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 nontemplated, 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.
- G. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered 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.
 6. Gap for butted or mitered joints in glass stop should not exceed .0625 inch.
- 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 after installation of frame in wall. 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 nontemplated, 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 manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames 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. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that will be filled with grout.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. 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. Field Supplied 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.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 - 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: 3/8 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. Threshold:
 - 1. Set threshold in a full bed of sealant.
 - 2. All door anchoring at the sill shall have fastener holes injected with sealant prior to permanent fastener installation.

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. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

SECTION 08 71 00 - DOOR HARDWARE**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. Commercial door hardware for the following:
 - a. Swinging doors.
- B. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1.3 SUBMITTALS

- A. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Details of electrified and access control hardware, indicating the following:
 - 1. System Block Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Include the following for each unique electrified opening:
 - a. Point-to-point system wiring and riser diagrams.
 - b. Elevation diagram of each door.
 - c. Operational description.
- C. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Furnish submittal in accordance with 013300 Submittal Procedures.
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 - a. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3.
 - 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 - 1) Sequence of Operation: Include description of component functions including, but not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

- D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- E. Maintenance Data: For each type of door hardware to include in maintenance manuals specified in Division 1. Upon completion of construction and building turnover, furnish two (2) complete maintenance manuals to the owner. Manuals to include the following items:
 - 1. Approved hardware schedule, catalog cuts and keying schedule.
 - 2. Furnish keying biting list in paper and electronic format by registered mail directly to facility manager owner.
 - 3. Hardware installation and adjustment instructions.
 - 4. Manufacturer's written warranty information.
 - 5. Wiring diagrams, elevation drawings and operational descriptions for all electronic openings.

1.4 QUALITY ASSURANCE

- A. Door Hardware Installer Qualifications: An experienced and factory trained Installer who has completed both standard and electrified builders hardware and integrated access control installations similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Door Hardware Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity which is not more than a half day of travel from the jobsite and who employs a qualified Architectural Hardware Consultant or equivalent experience available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying. Supplier recognized by manufacturers to be a direct factory-authorized distributor of the specified hardware products. Supplier is required to be available for onsite meetings with two days notice regarding issues that arise with opening functions, installation, keying, on-site warehousing, trouble shooting of products, and final punch out related issues.
 - 1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant (AHC) and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- D. Source Limitations: Obtain each type and variety of aluminum, steel and wood door hardware from the same single source manufacturer and supplier, unless otherwise indicated.
 - 1. Furnish electrified door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Furnish standard door hardware, electrified door hardware and access control door hardware as a single sourced package from the same qualified supplier.
 - 3. Furnish exterior door hardware from the same manufacturer as the interior door hardware, no deviations will be allowed.
- E. Regulatory Requirements: Comply with provisions of the following:
 - 1. Where indicated to comply with accessibility requirements, comply with "Americans with Disabilities Act" (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1, and "Texas Accessibility Standards" (TAS) as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
 - 2. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Thresholds: Not more than 1/2 inch high.
 - 3. Applicable building code, as indicated on drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Shipment of door hardware as detailed in approved Door Hardware Schedule Shop Drawings to be inventoried on site and upon receipt of material is secure in lock-up room furnished with shelving for door hardware. Do not store electronic access control hardware, software or accessories at Project site without prior authorization and climate controlled facility, failure to do so will void electronic warranties.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver permanent keys, cylinders, cores, access control credentials, electronic key software with loaded bitting and key records per cylinder, and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference". Hardware Supplier must be a regional supplier to address owner questions and concerns relating to keying issues that arise as project close-out ...

1.6 COORDINATION

- A. Templates: Door Hardware Supplier to furnish and distribute to the parties involved for templating for doors, frames, and other work specified to be factory prepared for installing standard, electrified and access control door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Access Control and Electrical Connections: Door Hardware supplier with door and frame supplier and security consultant to coordinate the layout and installation of scheduled electrified door hardware with required connections to source power junction boxes, power supplies and security products.
- C. Keying Conference: Door Hardware Supplier to conduct keying conference to comply with requirements in Division 1 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Review all lock and exit device functions when reviewing keying requirements.
 - 4. Requirements for key control system.
 - 5. Installation of permanent keys and cylinder cores.
 - 6. Address the requirements for delivery of keys.
 - 7. Address keying and cylinder stamping (identification) as required by owner or owner representative.
 - 8. Establish method of submitting electronic format of keying systems and diagram and to be produced and furnished by Hardware Supplier.
- D. Pre-Installation Conference: Hardware Supplier to conduct conference at Project site attended by representatives of Door Hardware Manufacturers, Hardware Installers, Owner Representative and General Contractor to review proper hardware installation methods and the procedures for receiving and handling hardware. On site training should address a minimum installation of each piece of hardware (electrical, closers, locksets, cylinders and exit devices) by qualified Hardware Supplier and Manufacturers. At completion of installation and final walk through, furnish written certification that hardware items were applied according to conference recommendations and to finish hardware specifications.

1.7 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of standard, electrified hardware and access control hardware that fails in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- C. Warranty Period: Two year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Five years for mortise locksets.
 - 2. Ten years for manual door closers.

3. Five years for Thresholds, Door Sweeps, Gasketing, Perimeter Weatherstripping.
 - E. Extended Warranty: As requested by the Owner, furnish a separate optional extended warranty and maintenance contract for power assist operated openings. .
- 1.8 MAINTENANCE SERVICE
- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools to Owner and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
 - B. Maintenance Service: Beginning at Substantial Completion, furnish six months' full maintenance by skilled employees of door hardware suppliers and installers. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Furnish parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY REQUIREMENTS

- A. Low Emitting Requirements: Provide product that meets low emitting criteria listed in section 01 81 13.02 – Sustainable Design Requirements.

2.2 SCHEDULED DOOR HARDWARE

- A. General: Furnish door hardware for each door to comply with requirements in this Section and the Door Hardware Schedule at the end of Part 3.
 1. Door Hardware Sets: Furnish quantity, item, size, finish or color indicated for named products listed in Hardware Sets.
 2. Sequence of Operation: Furnish electrified and access control hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Schedule at the end of Part 3. Products are identified by using door hardware designations, as follows:
 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule. (Source manufacturer listed in boldface).

2.3 HINGES AND PIVOTS

- A. Manufacturers: Subject to compliance with requirements, furnish products by one of the following:
 1. Hinges:
 - a. Hager Companies (HA).
 - b. McKinney Products (MC).
 - c. Stanley Hardware (ST).
 - d. Ives (IV)
 2. Continuous Barrel Hinges (Stainless Steel):
 - a. McKinney Products (MC).
 - b. Markar Manufacturing (MA).
 - c. Pemko Manufacturing (PE).
 - d. Select Hinges (SH).
 - e. Ives (IV)
- B. Standards: BHMA Certified products complying with the following:
 1. Butts and Hinges: BHMA A156.1.
 2. Continuous Geared Hinges: BHMA A156.26.
 3. Template Hinge Dimensions: BHMA A156.7.
- C. Quantity: Furnish the following, unless otherwise indicated:
 1. Two Hinges: For doors with heights up to 60 inches
 2. Three Hinges: For doors with heights 61 to 90 inches
 3. Four Hinges: For doors with heights 91 to 120 inches

- D. For doors with heights more than 120 inches furnish 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches. Pivot Hinges: Furnish 3/4" offset, single acting pivots with one intermediate pivot for doors less than 91 inches high and two intermediate pivots for doors between 91 inches and 121 inches in height. Space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high.

- E. Hinge Size: Furnish the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

Maximum Door Size (inches)	Hinge Height (inches)	Metal Thickness (inches)	
		Standard Weight	Heavy Weight
36-in by 86-in by 1-3/4	4-1/2	0.134	0.180
< 36-in by 120-in by 1-3/4	5	0.146	0.190

- F. Hinge Weight and Base Material: Unless otherwise indicated, furnish the following:
1. Exterior Doors: Heavy weight, non-ferrous, ball bearing hinges.
 2. Interior Doors: Heavy weight, ball bearing hinges unless Hardware Sets indicate standard weight.
 - a. Standard weight hinges can be used at Mechanical, Electrical, IDF, Data, and Offices with out closers openings, regardless of specified hinge weight in hardware sets.
- G. Hinge Height Clarifications: Where uneven door leafs occur, the widest door leaf in the pair determines the height and weight of the hinges on the inactive and active door leafs; to ensure equal size hinges on opening.
- H. Hinge Weight Clarification: If heavy weight hinges are specified in hardware sets for interior aluminum frames then standard weight hinges can be used. If aluminum frame opening has a door 42 inches or greater then provide an additional hinge in lieu of heavy weight or 5 inch hinges.
- I. Hinge Options: Comply with the following where indicated in the Door Hardware Schedule or on Drawings:
1. Non-removable Pins: Furnish set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
 - a. Out-swinging exterior doors.
 - b. Out-swinging access controlled doors.
 2. Electric Hinges: Furnish electric transfer hinges with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Furnish sufficient number of concealed wires to accommodate electric function of specified hardware.
- J. Continuous Barrel Hinges (Stainless Steel): Hinges to be made of 14 GA. type 304 Stainless Steel with concealed Teflon-coated stainless steel pin, and twin self-lubricated nylon bearings at each 2 inch knuckle. Fabricate hinges non-handed and to template screw locations.
- K. Accessible Electrical Transfer Continuous Hinges: Furnish electric transfer continuous hinges with a 12" removable hinge modification accessible without de-mounting door from the frame and standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Furnish sufficient number of concealed wires to accommodate electric function of specified hardware.
- L. Electrical Power Transfer: Furnish EPT where it is required per exit device manufactures requirements and warranty for more than 1 amp of inrush for latch retraction of exit device bolt. Furnish prep in door, frame, and continuous hinge. Furnish a secure and unobtrusive means of channeling electrical wiring from the door frame into the door itself by concealing internal wires for low voltage electrified door hardware. Furnish an Electrical Power Transfer fully manufactured with metal.
1. Acceptable Manufacturers:
 - a. Securitron Door Controls (SN) – EL-CEPT-12/22 series
 - b. Von Duprin (VO) – EPT-10 Series
- M. Furnish mortar guard enclosure on frames at each electrical hinge location specified.

2.4 LOCKS AND LATCHES

- A. Manufacturers: Subject to compliance with requirements, furnish products by one of the following:
1. Mechanical Mortise Locks and Latches:
 - a. Schlage (SC) – L9000 Series
- B. Standards: Comply with the following:
1. Mortise Locks and Latches: BHMA A156.13.

2. Interconnected Locks and Latches: BHMA A156.12.
 3. Auxiliary Locks: BHMA A156.5.
- C. Mortise Locks: BHMA Certified Grade 1, Series 1000.
- D. Interconnected Locks: BHMA Certified Grade 2, Series 5000.
- E. Auxiliary Locks: BHMA Certified Grade 1.
- F. Lock Trim: Match the following design style:
1. Levers:
 - a. Schlage (SC) – 06A/RHO
- G. Lock Functions: Function numbers and descriptions indicated in the Door Hardware Schedule comply with the following:
1. Mortise Locks: BHMA A156.13.
 2. Bored Locks: BHMA A156.2.
 3. Interconnected Locks: BHMA A156.12.
- H. Lock Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:
1. Mortise Locks: Minimum 3/4-inch latch bolt throw, with stainless steel bolt.
 2. Bored Locks: Minimum 1/2-inch latch bolt throw, 3/4" latch bolt throw at fire rated pairs.
 3. Deadbolts: Minimum 1-inch bolt throw.
- I. Backset: 2-3/4 inches unless otherwise indicated.

2.5 CYLINDERS AND KEYING

- A. Furnish Patented, High, Security cylinders utilizing a unique factory code pattern that is both geographically and time zoned protected. A letter of authorization under the letterhead of the End User must accompany purchases of any products which involve patented cylinders, keys and accessories. Manufacturers of patented security cylinders to allow the ability for both security and conventional cylinders to be used together under the same facility master or grandmaster key system. The End User is required to have the ability for on-site cylinder pinning and original key cutting.
- B. Manufacturers: Subject to compliance with requirements, furnish products by one of the following:
1. Patented Cylinders:
 - a. Schlage (SC) – Everest Patented Cylinders.
- C. Standards: Comply with the following:
1. Cylinders: BHMA A156.5.
 2. Key Control System: BHMA A156.5.
- D. Cylinder Grade: BHMA Certified Grade 1.
- E. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- F. Construction Keying: Comply with the following:
1. Construction Master keying: Furnish temporary construction master keyed cores that are replaceable by permanent cores. Furnish construction master keys in quantity as required by project Contractor.
- G. Keying System: Unless otherwise indicated, furnish for a keying system complying with the following requirements:
1. New Grand Master Key System: Cylinders are factory keyed operated by a change key, master key, and a grand master key. Conduct keying meeting with End User to define and document keying system instructions and requirements.
- H. Keys: Furnish nickel-silver keys complying with the following:
1. Stamping: Permanently inscribe each key with a visual key control number and as directed by Owner.
 2. Quantity: Furnish the following:
 - a. Cylinder Change Keys (Per Key Set): Four.
 - b. Master Keys (Per Level): Five.
 - c. Grand Master Keys: Two.

- d. Construction Control Keys: Two.
 - e. Permanent Control Keys: Two.
 - f. Extra Keyed Permanent Cores: Ten.
 - g. Extra Blank Keys: Fifty.
- I. Key Registration List: Furnish keying transcript list to Owner's representative for lock cylinders.
 - J. Key Control System: Furnish one lockable cabinet for key control and storage for up to 150 percent capacity, type and model to be determined in the keying meeting with the owner. Furnish End User with one copy of "Key Wizard" key management software program.

2.6 STRIKES

- A. Manufacturers: Subject to compliance with requirements, furnish products by one of the following:
 - 1. Electric Strikes: BHMA Certified Grade 1.
 - a. Folger Adam EDC (FO) – 300, 700 Series.
 - b. Hanchett Entry Systems (HES) – 1000, 5900, 9600 Series.
 - c. Von Duprin (VO) 4200, 5100, 6200, 6300, 6400 Series.
- B. Standards: Comply with the following:
 - 1. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 2. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 3. Strikes for Interconnected Locks and Latches: BHMA A156.12.
 - 4. Strikes for Auxiliary Deadlocks: BHMA A156.5.
 - 5. Dustproof Strikes: BHMA A156.16.
 - 6. Electric Strikes: BHMA A156.5.
- C. Strikes: Furnish manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Furnish manufacturer's special strike box fabricated for aluminum framing.

2.7 CLOSERS and POWER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, furnish products by one the following:
 - 1. Surface-Mounted Closers (Heavy Duty): BHMA Certified Grade 1.
 - a. LCN Door Closers (LC) – 4040XP Series with heavy duty arms.
- B. Standards: Comply with the following:
 - 1. Closers: BHMA A156.4.
- C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Furnish non-handed, factory-sized closers adjustable to meet field conditions and requirements for opening force.
- D. Closer Options: As indicated in hardware sets, furnish door closer options including: delayed action, hold open arms, extra duty parallel arms, positive stop/hold open arms, compression stop/hold open arms, special mounting brackets, spacers and drop plates. Through bolt type mounting is required as indicated in the door hardware sets. Where through bolts are used, coordinate the color of bolt on opposite of device with BHMA finish color similar to the color of door finish surface.
 - 1. Furnish Delayed Action (DA) feature in closers at Laboratories, Shipping and Receiving doors and where cart traffic is active.
 - 2. Furnish shock absorbing arm such as Spring or Rubber Cushion at exterior outswing openings.
- E. Power assist operators as surface mounted, electric low energy type conforming to ANSI A156.19 requirements and capable of meeting ANSI A117.1 guidelines. Outputs and relays required to be on board in the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
 - 1. Outputs and relays on board the operator allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
 - 2. Electronic Controls to be microprocessor controlled unit shall control the operation and switching of the swing power operator. The electronic control furnished with low voltage power supply for all means of actuation. Electronic encoder to determine absolute open and close position.

2.8 OPERATING AND PROTECTIVE TRIM UNITS

- A. Manufacturers: Subject to compliance with requirements, furnish products by one of the following:
 - 1. Metal Protective Trim Units:
 - a. McKinney Products (MC).
 - b. Ives (IV).
 - c. Rockwood Manufacturing (RO).
 - d. Trimco Manufacturing (TR).
- B. Standard: Comply with BHMA A156.6.
- C. Materials: Fabricate protection plates from the following:
 - 1. Brass/Bronze and Stainless Steel: .050 inchesthick, beveled four sides (B4E) with countersunk screw holes.
- D. Push-Pull Design: 1" Round with 10" Centers. Furnish 90 degree offset pulls at exterior openings.
- E. Fasteners: Furnish manufacturer's designated fastener type as indicated in door hardware sets.
- F. Furnish protection plates sized 2 inchesless than door width (LDW) on push side and 1 inch less door width on pull side by height specified in door hardware sets.
- G. Coordinate stainless steel hinges, door edges, kickplates and armor plates with less then .09375 inches between meeting edges, regardless of specified sizes in hardware sets.

2.9 DOOR THRESHOLDS, WEATHERSTRIPPING AND GASKETING

- A. Manufacturers: Subject to compliance with requirements, furnish products by one of the following:
 - 1. Door Thresholds, Weatherstripping and Gasket Seals:
 - a. McKinney Weatherstripping Products (MW).
 - b. NGP Manufacturing (NG)
 - c. Pemko Manufacturing (PE).
 - d. Zero International (ZE)
- B. Standard: Comply with BHMA A156.22.
- C. General: Furnish continuous weatherstrip seal on exterior doors and smoke, light, or sound gasketing on interior doors where specified. Furnish non-corrosive fasteners for exterior applications.
 - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Install header seal before mounting door closer arms.
 - 2. Meeting Stile Astragals: Fasten to meeting stiles, forming seal when doors are closed.
 - 3. Door Sweep: Apply to bottom of door, forming seal with threshold when door is closed.
- D. Basic Sound Seal Requirement: Whether indicated on the drawings or not, furnish gasketing MCKS88BL at sound rated wall types and at the following areas for limiting of sound transmission: private offices, exams, conference, private toilets, corridor openings, rooms and similar sound sensitive area.
- E. Provide Perimeter Weatherstripping at Exterior Hollow Metal Frames, Install prior to templating and installing exit devices and closers:
 - 1. Exterior Outswing/Inswing Openings:
 - a. McKinney Weatherstripping Products (MW):MCK2891APK
 - b. NGP Manufacturing (NG): 700UA
 - c. Pemko Manufacturing (PE): 2891APK
- F. Provide Door Bottom Sweeps at Outswing Doors:
 - 1. Exterior Outswing Openings without Overhead Protection:
 - a. McKinney Weatherstripping Products (MW):MCK345ANB
 - b. NGP Manufacturing (NG): C627A
 - c. Pemko Manufacturing (PE): 345ANB
 - 2. Exterior Outswing Openings with Overhead Protection:
 - a. McKinney Weatherstripping Products (MW): MCK315CN
 - b. NGP Manufacturing (NG): 202NA
 - c. Pemko Manufacturing (PE): 315CN
 - 3. Exterior Hollow Metal Inswing Openings with or with out Overhead Protection:
 - a. McKinney Weatherstripping Products (MW): MCK420APKL
 - b. NGP Manufacturing (NG): 320N
 - c. Pemko Manufacturing (PE): 420APKL

G. Provide Rain Drips at Exterior Openings without Overhead Protection:

1. Rain Drips:
 - a. McKinney Weatherstripping Products (MW): MCK346C
 - b. NGP Manufacturing (NG): 16A
 - c. Pemko Manufacturing (PE): 346C

H. Provide Thresholds at Exterior Openings:

1. Exterior Outswing Openings:
 - a. McKinney Weatherstripping Products (MW): MCK2005AT
 - b. NGP Manufacturing (NG): 896
 - c. Pemko Manufacturing (PE): 2005AT
2. Exterior Inswing Openings:
 - a. McKinney Weatherstripping Products (MW): MCK171A
 - b. NGP Manufacturing (NG): 425
 - c. Pemko Manufacturing (PE): 171A

2.10 FABRICATION

- A. Fasteners: Furnish door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Furnish screws according to manufacturers recognized installation standards for application intended.
 1. Furnish manufactures templated and approved stainless steel screws and fasteners for stainless steel hardware specified in the hardware sets.
- B. Mounting Accessories: Furnish drop plates, filler brackets, extended length screws, through bolts, and accessories for complete mounting with door, frame, light kits, applied molding and special applications as part of the base bid with complete installation per manufactures recommendations.
 1. In healthcare facilities install surface mount magnetic locks on the pull side of the doors when specified in hardware sets and located on openings in corridors. Furnish all mounting brackets with finish and beauty covers.

2.11 FINISHES

- A. Standard: Comply with BHMA A156.18.
- B. Furnish quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable and temporary protective covering before shipping to jobsite.
- D. Finishes on locksets, latchsets and exit devices to incorporate an FDA recognized antimicrobial coating (MicroShield) listed for use on medical and food preparation equipment that will suppress the growth and spread of a broad range of bacteria, algae, fungus, mold and mildew.
- E. Furnish clear powder coat finish at exit devices located on exterior openings such as gates and at pool exit doors.
- F. BHMA Designations: Comply with base material and finish requirements indicated by the following:
 1. BHMA 600: Primed for painting, over steel base metal.
 2. BHMA 605: Bright brass, clear coated, over brass base metal.
 3. BHMA 606: Satin brass, clear coated, over brass base metal.
 4. BHMA 609: Satin brass, blackened, satin relieved, clear coated, over brass base metal.
 5. BHMA 611: Bright bronze, clear coated, over bronze base metal.
 6. BHMA 612: Satin bronze, clear coated, over bronze base metal.
 7. BHMA 613: Dark-oxidized satin bronze, oil rubbed, over bronze base metal.
 8. BHMA 618: Bright nickel plated, clear coated, over brass or bronze base metal.
 9. BHMA 619: Satin nickel plated, clear coated, over brass or bronze base metal.
 10. BHMA 622: Flat black coated, over brass or bronze base metal.
 11. BHMA 623: Light-oxidized statuary bronze, clear coated, over bronze base metal.
 12. BHMA 624: Dark-oxidized statuary bronze, clear coated, over bronze base metal.
 13. BHMA 625: Bright chromium plated over nickel, over brass or bronze base metal.
 14. BHMA 626: Satin chromium plated over nickel, over brass or bronze base metal.
 15. BHMA 627: Satin aluminum, clear coated, over aluminum base metal.
 16. BHMA 628: Satin aluminum, clear anodized, over aluminum base metal.

- 17. BHMA 629: Bright stainless steel, over stainless-steel base metal.
- 18. BHMA 630: Satin stainless steel, over stainless-steel base metal.
- 19. BHMA 651: Bright chromium plated over nickel, over steel base metal.
- 20. BHMA 652: Satin chromium plated over nickel, over steel base metal.
- 21. BHMA 689: Aluminum painted, over any base metal.
- 22. BHMA 690: Dark bronze painted, over any base metal.
- 23. BHMA 691: Light bronze painted, over any base metal.
- 24. BHMA 717: Bright aluminum, uncoated; aluminum base metal.
- 25. BHMA 718: Satin aluminum, uncoated; aluminum base metal.
- 26. BHMA 722: Dark-oxidized bronze, oil rubbed, over architectural bronze base metal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical source power to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Steel Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- C. Furnish and coordinate concealed wood blocking for wall mount stops as detailed in Door Hardware Schedule.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 FIELD QUALITY CONTROL

- A. The Contractor shall comply with AIA A201 1997 section 3.3.1 which reads as follows: "The 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 under the Contract, unless the contract Documents give other specific instructions concerning these matters."
- B. Field Inspection: Supplier and Door Hardware Manufacturer will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.
 - 1. Access Control System Consultant will inspect integrated electronic and access control hardware and state in report whether installed work complies with or deviates from requirements, including

whether electronic and access control hardware is properly installed and performing according to system operational descriptions.

- a. Inspection: Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.
- b. Pre-testing: Program and adjust the system and pretest all components, wiring, and functions to verify they conform to specified requirements. Replace malfunctioning or damaged items with new items.
- c. Acceptance Test Schedule: Schedule tests after pre-testing has been successfully completed and system has been in normal functional operation for at least 2 weeks.
- d. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 1. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- B. Six-Month Adjustment: Approximately six months after date of Substantial Completion, Installer shall perform the following:
 1. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.
 2. Consult with and instruct Owner's personnel on recommended maintenance procedures.
 3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper finish. Furnish final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.8 DOOR HARDWARE SETS

- A. The hardware sets listed below represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections.
- B. Abbreviations used in hardware schedule.
 1. A/C – Access Control
 2. A/O – Automatic Operator
 3. CEMHO – Closer Mount Electromagnetic Hold Open
 4. Dbl Cyl – Double Cylinder
 5. DT – Dummy trim
 6. EMHO – Electromagnetic Hold Open
 7. HO – Hold open
 8. LDW – Less door width.
 9. M/L – Magnetic Lock
 10. NL – Night Latch
 11. OW – Opening width.
 12. PA – Parallel arm.
 13. Reg – Regular arm mount.
 14. SNB – Sex Nut and bolts
 15. TB – Through bolts

16. TJ – Top Jamb mount

Hardware Group No. 205

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080T 06A	630	SCH
1	EA	FSIC CORE	23-030 (MATCH FACILITY KEYWAY)	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	RAIN DRIP	142A DW + 4" REPLACE AS REQ	AA	ZER
1	SET	GASKETING	328AA H & J REPLACE AS REQ	AA	ZER
1	EA	THRESHOLD SEAL	475AA LENGTH AS REQ	AA	ZER
1	EA	DOOR SWEEP	8198AA LENGTH AS REQ REPLACE AS REQ	AA	ZER
2	EA	ROOF CURB THRESHOLD	105-NH LENGTH AS REQ ANCHORS AS REQUIRED	A	ZER
1	EA	ADJUSTABLE SADDLE	672NH - 6710NH WIDTH AND LENGTH AS REQ FASTENERS AS REQUIRED	A	ZER

END OF SECTION

SECTION 09 91 00 - PAINTING**PART 1 - GENERAL****1.1 SUMMARY**

- A. Related Documents: General and Supplementary Conditions of the Contract, Division 01 General Requirements, and Drawings are applicable to this Section.
- B. Section Includes:
 - 1. Complete surface preparation and finishing for field application of coatings and requirements for field finishing mechanical and electrical equipment.
 - 2. Examine specifications for various other trades and their provisions regarding their painting. Surfaces that are left unfinished by other sections of the specifications shall be painted or finished as a part of this Section.
 - 3. Colors, including deep tones, will be selected by the Architect. Number of colors to be used on job will be determined by Architect.

1.2 SURFACES NOT TO RECEIVE FIELD FINISHING

- A. Do not paint copper, bronze, chrome plated items, nickel, stainless steel, Monel metal, lead, face brick, prefinished wall, ceiling, and floor coverings, items with factory applied final finish (except where exposed on roofs and in finished spaces), elevator shafts, crawl spaces, chases, and plenums above suspended ceilings unless otherwise specified or scheduled.

1.3 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.4 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with 3 years experience.
- B. Applicator: Company specializing in commercial painting and finishing with 2 years experience.
- C. Product Labels: Include manufacturer's name, type of paint, stock number, color and label analysis on label of containers.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable building code for flame spread/fuel contribution/smoke development rating requirements for finishes.
- B. Comply with applicable city, county, state, and federal requirements and ordinances regarding maximum VOC (Volatile Organic Compound) content of all coatings.

1.6 TESTS

- A. Provide periodic testing with Wet Film Thickness gage to verify that proper thickness of finish coatings are being applied.

1.7 SUBMITTALS

- A. Provide product data describing physical performance criteria and composition on all finishing products.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protect products under provisions of Division 1 section "Product Requirements"
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.
- C. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

- D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
- E. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the ranges required by paint manufacturer.
- B. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is above 75 percent, unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish and Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles measured mid- height at substrate surface.

1.10 EXTRA STOCK

- A. Provide a 5 gallon container of each color to Owner.
- B. Label each container with color, color number, texture, and room locations, in addition to the manufacturer's label.

1.11 SCAFFOLDS AND PROTECTION

- A. Provide adequate safe ladders, scaffolds, and stages necessary to complete work.
- B. Protect completed finish and paint work, and protect adjacent finish surfaces from paint splatter, spills and stains. Use adequate drop cloths and masking procedures during progress of work.

1.12 PRECAUTIONS

- A. Do not store paints, oils, thinners and other flammable items inside the building and shall be stored in approved containers when not in actual use during the painting job. The fire hazard shall be kept at a minimum.
- B. Precaution shall be taken to protect the public and construction workers during the progress of the work.
- C. Furnish a temporary fire extinguisher of suitable chemicals and capacity, located near flammable materials.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY REQUIREMENTS

- A. Low Emitting Requirements: Provide product that meets low emitting criteria listed in section 018113.02 – Sustainable Design Requirements.

2.2 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements indicated, provide products of one of the following:
 - 1. Benjamin Moore.
 - 2. Pittsburgh Paints Company.
 - 3. Sherwin-Williams.
- B. Materials selected for coating systems for each type surface shall be product of a single manufacturer unless otherwise specified. Secondary products such as linseed oil, turpentine and shellacs shall be first quality products of a reputable manufacturer.

2.3 MATERIALS

- A. Coatings: Ready mixed. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating with good flow and brushing properties; capable of drying or curing free of streaks or sags.
- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- C. Patching Materials: Latex filler.

2.4 FINISHES

- A. Color and Sheen: As indicated on Drawings.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report to Architect any condition that may potentially affect proper application.
- C. Test shop applied primers for compatibility with subsequent cover materials.
- D. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 PREPARATION

- A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
- B. Correct minor defects and clean surfaces which affect work of this Section. Remove existing coatings which exhibit loose surface defects.
- C. Shellac and seal marks which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Hot-Dipped Galvanized Surfaces: Prepare surfaces using methods recommended in writing by coating manufacturer, but not less than the following:
 - 1. SSPC-SP 16 "Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals".
- F. Pre-Weathered Galvanized Surfaces: For galvanized metal with at least 6 months of in-place weathering, comply with requirements in SSPC-SP 1 "Solvent Cleaning".
- G. Electroplate Galvanized Surfaces: Comply with requirements in SSPC-SP 1 "Solvent Cleaning". Apply coat of manufacturer approved wash primer.
- H. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- I. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- J. Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

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. Metal:

1. Remove rust from surfaces to bare metal in accordance with SP3 "Power Tool Cleaning".
2. Exercise care not to remove galvanizing.
3. Complete preparation as specified for new work.

3.4 PROTECTION

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.5 APPLICATION

- A. The intent of these Specifications is to produce the highest quality appearance of paint and finish surfaces. Employ skilled mechanics only. The proper preparation of all surfaces will be strictly enforced and wherever finished surfaces show any defects due to improper preparation, workmanship, etc., the defects shall be removed and the work refinished at the expense of the Contractor.
- B. Apply products in accordance with manufacturer's instructions. Final finish coats shall have visual evidence of solid hiding and uniform appearance, and shall be free and smooth of brush marks, streaks, sags, runs, laps, or skipped areas.
- C. Do not apply finishes to surfaces that are not dry.
- D. Apply each coat to uniform finish and thickness.
- E. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- F. Sand lightly between coats on wood and metal items to achieve required finish.
- G. Allow applied coat to dry before next coat is applied.
- H. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- I. Prime back surfaces of interior and exterior woodwork scheduled to be painted with primer paint.
- J. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.
- K. Edges of paint adjoining other materials or colors shall be sharp and clean with no overlapping.

3.6 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Paint all shop primed equipment. Paint shop prefinished items where exposed to view in finished spaces. In mechanical rooms, repair shop pre-finished coatings which have been scratched or otherwise damaged with identical touch-up paint. Sand prior to touching up as required.
- B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- C. Paint all grilles, registers, diffusers, and speaker grilles to match adjacent wall and ceiling surfaces, except that factory pre-finished items need not be painted if installed in a suspended acoustical ceiling system where the acoustical panels match the mechanical or electrical item color.
- D. In all finished spaces, prime and paint exposed pipes, conduit, boxes, ducts, hangers, brackets, collars and supports. Paint to match adjacent surfaces.

- E. Repair or replace identification markings on mechanical or electrical equipment when painted accidentally.
- F. Paint interior surfaces of air ducts and convectors that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convector to match face panels.
- G. Paint all surfaces of plywood backboards for electrical and telephone equipment before installing equipment.
- H. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.
- I. Paint exposed air handlers, roof ventilators, goose necks, exhaust fans and other items on the roof with 2 coats exterior enamel. Prepare surfaces in accordance with the base metal or primer as specified herein.
- J. Paint concrete support bases with gray floor deck enamel.
- K. Pipe hangers and other supports need not be painted except where installed in crawl spaces, where they shall be painted with a thick coat of asphaltic paint.

3.7 CLEANING/TOUCH-UP

- A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.
- D. Spot painting will be allowed to correct soiled or damaged paint surfaces only when touch-up spot will blend into surrounding finish and is invisible to normal viewing (as determined by the Architect). Otherwise, re-coat entire section to corners or to a visible stopping point.

3.8 V.O.C. (VOLATILE ORGANIC COMPOUND) COMPLIANCE

- A. Products listed in following schedule and/or substitutes proposed for use by Contractor must be formulated to meet all applicable ordinances and regulations regarding maximum V.O.C. content. Utilize products which have been specially formulated to need such requirements.

3.9 EXTERIOR PAINT SCHEDULE

- A. Shop Primed Metal Doors:
 - 1. High Performance Coating, Waterbased Urethane: (rust inhibitive, UV stable)
 - a. Benjamin Moore:
 - 1) Finish Coats: Two coats of Corotech Waterborne Urethane.
 - b. Pittsburgh Paints Company:
 - 1) Finish Coats: 2550 Waterborne Urethane Coating.
 - c. Sherwin-Williams:
 - 1) Finish Coats: Two coats Pro Industrial Waterbased Arcolon 100.
- B. Galvanized Surfaces:
 - 1. High Performance Coating, Water-Based Alkyd:
 - a. Benjamin Moore:
 - 1) Primer: One coat Corotech Acrylic Metal Primer
 - 2) Finish Coats: Two coats Advance Waterborne Interior Alkyd.
 - b. Pittsburgh Paints Company:
 - 1) Primer: One coat Pitt-Tech Direct-to-Metal.
 - 2) Finish Coats: Two coats Speedhide WB Alkyd.
 - c. Sherwin-Williams:
 - 1) Primer: One coat Pro Industrial Pro-Cryl Primer
 - 2) Finish Coats: Two coats Pro Industrial Waterbased Alkyd Urethane.

END OF SECTION

SECTION 220517
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Manufactured sleeve-seal systems.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.04 SUBMITTALS

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

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- C. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- D. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
 - 3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 MANUFACTURED SLEEVE-SEAL SYSTEMS

- A. Modular/Mechanical Seal:
 - 1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
 - 2. Provide watertight seal between pipe and wall/casing opening.

3. Elastomer element size and material in accordance with manufacturer's recommendations.
4. Glass reinforced plastic pressure end plates.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Provide sleeves when penetrating footings, floors, walls, partitions, and roofs. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- E. Manufactured Sleeve-Seal Systems:
 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.
 6. Install in accordance with manufacturer's recommendations.
- F. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

**SECTION 220519
METERS AND GAUGES FOR PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pressure gauges and pressure gauge taps.
- B. Thermometers and thermometer wells.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

- A. Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge.
 - 2. Ashcroft Inc.
 - 3. Dwyer Instruments, Inc.
 - 4. Flo Fab Inc.
 - 5. Miljoco Corporation.
 - 6. Palmer Wahl Instrument Corporation.
 - 7. Tel-Tru Manufacturing Company.
 - 8. Terice, H.O. Company.
 - 9. Watts Regulator.
 - 10. Weiss Instruments, Inc.
 - 11. Winters Instruments.
- B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 4-1/2 inch diameter.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Psi and kPa.

2.02 PRESSURE GAUGE TAPPINGS

- A. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.
- B. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.03 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc.
 - 2. Flo Fab Inc.
 - 3. Palmer Wahl Instrument Company.
 - 4. Tel-Tru Manufacturing Company.
 - 5. Terice, H.O. Company.
 - 6. Weiss Instruments, Inc.
 - 7. Winters Instruments.
- B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear glass.
 - 3. Stem: In inch length to suit installation; aluminum.
 - 4. Accuracy: 2 percent, per ASTM E77.
 - 5. Calibration: Degrees F.
- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Stem: 3/4 inch NPT brass.
 - 4. Accuracy: 2 percent, per ASTM E77.
 - 5. Calibration: Degrees F.

2.04 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.05 TEST PLUGS

- A. Manufacturers:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Terice, H.O. Company.
 - 6. Watts Regulator Company.
 - 7. Weiss Instruments.
- B. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- C. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation. Provide siphon on gauges in steam systems.

- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- E. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- F. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.02 SCHEDULES

- A. Pressure Gauges, Scale Range: 0 to 100 psi.
- B. Stem Type Thermometers, Scale Range: 30 to 200 deg. F.

END OF SECTION

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SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Applications.
- B. Ball valves.
- C. Butterfly valves.
- D. Check valves.
- E. Gate valves.
- F. Chainwheels.

1.02 RELATED REQUIREMENTS

- A. Section 220719 - Plumbing Piping Insulation.
- B. Section 221005 - Plumbing Piping.

1.03 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. TFE: Tetrafluoroethylene.
- J. WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- E. ASME B31.9 - Building Services Piping; 2020.
- F. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- G. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- H. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- I. MSS SP-45 - Drain and Bypass Connections; 2020.
- J. MSS SP-67 - Butterfly Valves; 2022.
- K. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- L. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.

- M. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- N. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- O. NSF 61 - Drinking Water System Components - Health Effects; 2020.
- P. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.05 SUBMITTALS

- A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball, butterfly, gate.
 - 2. Swing Check (Pump Outlet):
 - a. 2 NPS and Smaller: Bronze swing check valves with bronze disc.
 - b. 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control, metal seat check valves.
- B. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.
- C. Required Valve End Connections for Non-Wafer Types:
 - 1. Copper Tube:
 - a. 2 NPS and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - c. 5 NPS and Larger: Grooved or flanged ends.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:

1. Handwheel: Valves other than quarter-turn types.
 2. Hand Lever: Quarter-turn valves 6 NPS and smaller.
 3. 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.
- D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:
1. Gate Valves: Rising stem.
 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 3. Butterfly Valves: Extended neck.
- E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
 4. Solder Joint Connections: ASME B16.18.
- F. General ASME Compliance:
1. Building Services Piping Valves: ASME B31.9.
- G. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
 2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- H. Valve Bypass and Drain Connections: MSS SP-45.
- I. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, BALL VALVES

- A. General:
1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. One Piece, Reduced Port with Bronze Trim:
1. Comply with MSS SP-110.
 2. SWP Rating: 400 psig.
 3. CWP Rating: 600 psig.
 4. Body: Bronze.
 5. Ends: Press.
 6. Seats: PTFE.
- C. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
 2. SWP Rating: 150 psig.
 3. CWP Rating: 600 psig.
 4. Body: Forged bronze or dezincified-brass alloy.
 5. Ends: Threaded.
 6. Seats: PTFE.
 7. Stem: Stainless steel.
 8. Ball: Stainless steel vented.
 9. Manufacturers:
 - a. Apollo Flow Controls; Conbraco Industries.
 - b. Crane; Crane Energy Flow Solution.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.

- e. NIBCO Inc.
- f. Watts.

2.04 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug Style: Bi-directional dead-end service without use of downstream flange.
 - 1. Comply with MSS SP-67, Type I.
 - 2. CWP Rating: 200 psig.
 - 3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
 - 4. Stem: One or two-piece stainless steel.
 - 5. Seat: EPDM.
 - 6. Disc: Stainless steel.
 - 7. Manufacturers:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves or Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO Inc.
 - h. Red-White Valve Corporation.
 - i. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2.05 BRONZE, SWING CHECK VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125: CWP Rating: 200 psig (1380 kPa).
 - 1. Comply with MSS SP-80, Type 3.
 - 2. Design: Y-pattern, horizontal or vertical flow.
 - 3. Body: Bronze, ASTM B62.
 - 4. Ends: Threaded.
 - 5. Disc: Bronze.
 - 6. Manufacturers:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Milwaukee Valve Company.
 - d. NIBCO Inc.
 - e. Red-White Valve Corporation.

2.06 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125 with Lever and Weight-Closure Control.
 - 1. Comply with MSS SP-71, Type I.
 - 2. Description:
 - a. CWP Rating: 200 psig.
 - b. Design: Clear or full waterway.
 - c. Body: ASTM A126, gray iron with bolted bonnet.
 - d. Ends: Flanged as indicated.
 - e. Trim: Bronze.
 - f. Gasket: Asbestos free.

- g. Closer Control: Factory installed, exterior lever, and weight.
- 3. Manufacturers:
 - a. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves and Stockham Division.
 - b. Grinnel Corporation.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. Mueller Company.
 - f. NIBCO Inc.
 - g. Watts Industries.

2.07 IRON, GATE VALVES

- A. NRS or OS & Y:
 - 1. Comply with MSS SP-70, Type I.
 - 2. Class 125: CWP Rating: 200 psig.
 - 3. Body: ASTM A126, gray iron with bolted bonnet.
 - 4. Ends: Flanged.
 - 5. Trim: Bronze.
 - 6. Disc: Solid wedge.
 - 7. Packing and Gasket: Asbestos free.
 - 8. Manufacturers:
 - a. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves, or Stockham Division.
 - b. Flo Fab Inc.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Legend Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO Inc.
 - h. Watts Regulator Company.

2.08 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Attachment: For connection to ball and butterfly valve stems.
 - 2. Sprocket Rim with Chain Guides: Ductile iron. Include zinc coating.
 - 3. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.
- B. Manufacturers:
 - 1. Babbitt Steam Specialty Company.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 - 1. Swing Check: Install horizontal maintaining hinge pin level.
- E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION

SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Support and attachment components.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- E. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

1.04 QUALITY ASSURANCE

- A. Comply with applicable building code.

PART 2 PRODUCTS**2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Hanger Rods:
 - 1. Threaded zinc-plated steel unless otherwise indicated.
 - 2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch: 1/4 inch diameter.
 - c. Piping larger than 1 inch: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch in length.
- C. Thermal Insulated Pipe Supports:

1. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Pipe supports to be provided for nominally sized 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
- D. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- E. Anchors and Fasteners:
 1. Manufacturers - Mechanical Anchors:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries.
 - c. Hilti, Inc.
 - d. ITW Red Head, a division of Illinois Tool Works, Inc.
 - e. Powers Fasteners, Inc.
 - f. Simpson Strong-Tie Company Inc.
 2. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Hilti, Inc.
 - b. ITW Ramset, a division of Illinois Tool Works, Inc.
 - c. Masterset Fastening Systems, Inc.
 - d. Powers Fasteners, Inc.
 - e. Simpson Strong-Tie Company Inc.
 3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 4. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.

1.02 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.03 SUBMITTALS

- A. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- B. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Piping: Pipe markers.
- B. Tanks: Nameplates.
- C. Valves: Tags and ceiling tacks where located above lay-in ceiling.
- D. Water Treatment Devices: Nameplates.
- E. Water Heaters and All Other Plumbing Equipment: Nameplates.

2.02 NAMEPLATES

- A. Minimum Size: Length and width vary for required label content, but not less than 2-1/2 inch by 1 inch.
- B. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: Black.
 - 4. Plastic: Comply with ASTM D709.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is identified (plans, details, and schedules), plus the specification number and title where the equipment is specified.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

- A. Comply with ASME A13.1.

- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Label Contents: Include identification of piping system service using same designations as used on the 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 a separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: 1-1/2 inch minimum.

2.05 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 - 1. HVAC Equipment: Yellow.
 - 2. Fire Dampers and Smoke Dampers: Red.
 - 3. Plumbing Valves: Green.
 - 4. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- F. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

**SECTION 220719
PLUMBING PIPING INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Piping insulation for supplies and drains for handicap-accessible lavatories and sinks.
- C. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).
- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- J. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- K. ICC A117.1 - Supply and Drain Protective Shield Covers.
- L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

- A. Manufacturers:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville Corporation.
 - 3. Knauf Insulation.
 - 4. Owens Corning Corporation.
 - 5. Manson Insulation Inc.; Alley-K.
 - 6. Owens Corning Corporation.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Aeroflex USA, Inc.
 - 2. Armacell LLC.
 - 3. K-Flex USA LLC.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.

2.04 JACKETS

- A. PVC Plastic.
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive.
- B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch laps.
 - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.05 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Manufacturers:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot and cold water supplies, trap, and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
 - 3. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
 - a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
 - b. Comply with ICC A117.1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

- 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.
- J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULES

- A. Plumbing Systems:
 - 1. Domestic Cold Water:
 - a. Pipe Size Range: All Sizes
 - 1) Type: Glass Fiber
 - 2) Thickness: 1 inch
 - 2. Domestic Hot and Recirculated Water:
 - a. Pipe Size Range: NPS 1-1/4 and smaller
 - 1) Type: Glass Fiber
 - 2) Thickness: 1 inch
 - b. Pipe Size Range: NPS 1-1/2 and larger
 - 1) Type: Glass Fiber
 - 2) Thickness: 1-1/2 inch
 - 3. Roof Drain and Overflow Drain Bodies:
 - a. Pipe Size Range: All Sizes
 - 1) Type: Glass Fiber
 - 2) Thickness: 1 inch
 - 4. Stormwater and Overflow:
 - a. Pipe Size Range: All Sizes
 - 1) Type: Glass Fiber
 - 2) Thickness: 1 inch
 - 5. Condensate Piping from HVAC Systems:
 - a. Pipe Size Range: All Sizes
 - 1) Type: Glass Fiber or Flexible Elastomeric
 - 2) Thickness: 1 inch

END OF SECTION

**SECTION 221005
PLUMBING PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, specialties, and connections for piping systems.
 - 1. Sanitary sewer.
 - 2. Domestic water.
 - 3. Piping for HVAC condensate.
 - 4. Storm water.
 - 5. Pipe hangers and supports.

1.02 REFERENCE STANDARDS

- A. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- D. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.
- E. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.
- F. ASME B31.1 - Power Piping; 2024.
- G. ASME B31.9 - Building Services Piping; 2020.
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- I. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- J. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- L. ASTM B32 - Standard Specification for Solder Metal; 2020.
- M. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
- N. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- P. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.
- Q. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- R. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- S. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- T. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).
- U. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2024.

- V. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- W. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2024, with Editorial Revision (2025).
- X. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2020b.
- Y. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2020.
- Z. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing; 2021.
- AA. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- BB. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
- CC. NSF 61 - Drinking Water System Components - Health Effects; 2020.
- DD. NSF 372 - Drinking Water System Components - Lead Content; 2020.
- EE. PPI TR-4 - PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe; 2017.

1.03 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
 1. Fittings: Cast iron.
 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 1. Fittings: Cast iron.
 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. Copper Tube: ASTM B306, DWV.
 1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, solvent.
 2. Joints: ASTM B32, alloy Sn50 solder.
- D. PVC Pipe: ASTM D2665.
 1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.
 3. PVC piping installed in return air plenums shall be wrapped to meet ASTM E84 25/50 rating or shall be manufactured to meet applicable ratings to be installed in plenums.

2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B42, annealed.
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.
- B. Cross-Linked Polyethylene (PEX-a) Pipe: ASTM F876 or ASTM F877.
 1. PPI TR-4 Pressure Design Basis:
 - a. 160 psig at maximum 73 degrees F.
 - b. 100 psig at maximum 180 degrees F.
 - c. 80 psig at maximum 200 degrees F.
 2. Fittings: Brass and copper.
 3. Joints: ASTM F1960 cold-expansion fittings.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE, AND PIPING FOR HVAC CONDENSATE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.
 3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) Elkhart Products Corporation.
 - 2) Grinnell Products, a Tyco Business.
 - 3) NIBCO Inc.
 - 4) Viega LLC.
- B. Cross-Linked Polyethylene (PEX-a) Pipe: ASTM F876 or ASTM F877.
 1. PPI TR-4 Pressure Design Basis:
 - a. 160 psig at maximum 73 degrees F.
 - b. 100 psig at maximum 180 degrees F.
 - c. 80 psig at maximum 200 degrees F.
 2. Fittings: Brass and copper.
 3. Joints: ASTM F1960 cold-expansion fittings.

2.06 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.07 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- 1. Fittings: ASTM A234/A234M, wrought steel welding type.

2.08 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded or welded to ASME B31.1.

2.09 PIPE HANGERS AND SUPPORTS

- 1. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
- 2. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High-density polypropylene.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
 - e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.
- B. Plumbing Piping - Drain, Waste, and Vent:
 - 1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
 - 2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 3. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 4. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
- C. Plumbing Piping - Water:
 - 1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, adjustable swivel, split ring.
 - 2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 3. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
 - 5. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- C. Provide access where valves and fittings are not exposed.

- D. Install valves with stems upright or horizontal, not inverted. See Section 220523.
- E. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- F. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as indicated.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 8. Provide copper plated hangers and supports for copper piping.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.

3.04 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
 - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 - 2. Provide 18 gauge, 0.0478-inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.05 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1. Metal Piping:
 - a. Pipe Size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inches to 2 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.
 - c. Pipe Size: 2-1/2 inches to 3 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 1/2 inch.
 - d. Pipe Size: 4 inches to 6 inches:

- 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 5/8 inch.
 - e. Pipe Size: 8 inches to 12 inches:
 - 1) Maximum hanger spacing: 14 ft.
 - 2) Hanger Rod Diameter: 7/8 inch.
- B. Piping Applications:
 1. Under slab, domestic water piping, NPS 2 and smaller, shall be: Type L, drawn-temper copper tubing, wrought-copper fittings, brazed or mechanical pressure-seal joints.
 2. Under slab, domestic water, building service piping, NPS 3 to NPS 6, shall be: Type K, wrought copper tubing, solder joint fittings, brazed or mechanical pressure-seal joints.
 3. Above ground, domestic water piping, all sizes, shall be one of the following:
 - a. Type L, drawn-temper copper tubing, wrought-copper fittings, soldered or mechanical pressure-seal joints.
 - b. PEX-a piping with engineered polymer (EP) or lead-free brass ASTM F1960 cold-expansion fittings.
 4. Piping for HVAC condensate, all sizes, shall be: Type L, drawn-temper copper tubing, wrought-copper fittings, soldered or mechanical pressure-seal joints.
 5. Under slab, soil, waste and vent piping, all sizes, shall be one of the following:
 - a. Cast iron, hub-and-spigot, gaskets, and gasketed joints.
 - b. Cast iron, hubless, CISPI hubless couplings, and coupled joints.
 - c. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Above ground, soil and waste piping, all sizes, shall be one of the following:
 - a. Cast iron, hub-and-spigot, gaskets, and gasketed joints.
 - b. Cast iron, hubless, solvent stack fittings, CISPI hubless couplings, and coupled joints.
 - c. Copper DWV tube, copper drainage fittings, and soldered joints.
 - d. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 7. Above ground, vent piping, all sizes, shall be one of the following:
 - a. Cast iron, hub-and-spigot, gaskets, and gasketed joints.
 - b. Cast iron, hubless, CISPI hubless couplings, and coupled joints.
 - c. Copper DWV tube, copper drainage fittings, and soldered joints.
 - d. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

**SECTION 221006
PLUMBING PIPING SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Refrigerator or icemaker valve and recessed box.
- F. Backflow preventers.
- G. Double check valve assemblies.
- H. Water hammer arrestors.
- I. Balancing Valves.
- J. Stainers.
- K. Flexible Connectors.
- L. Trap Seal Primer Device.

1.02 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor Drains; 2022.
- B. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.
- C. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.
- D. NSF 61 - Drinking Water System Components - Health Effects; 2020.
- E. NSF 372 - Drinking Water System Components - Lead Content; 2020.
- F. PDI-WH 201 - Water Hammer Arresters; 2017.

1.03 SUBMITTALS

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company.
 - 2. Josam Company.
 - 3. MIFAB, Inc.
 - 4. Tyler Pipe; Wade Division.
 - 5. Watts Drainage Products Inc.
 - 6. Zurn Industries, LLC.
- B. Floor Drain:

1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.
- C. Floor Sink:
1. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, nickel bronze frame, full or half grate (refer to schedule on drawings).

2.03 CLEANOUTS

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company.
 2. Josam Company.
 3. MIFAB, Inc.
 4. Tyler Pipe; Wade Division.
 5. Watts Drainage Products Inc.
 6. Zurn Industries, LLC.
- B. Cleanouts at Interior Finished Floor Areas:
1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- C. Cleanouts at Interior Finished Wall Areas:
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- D. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company.
 2. Watts Regulator Company.
 3. Zurn Industries, LLC.
 4. Approved equivalent manufacturer.
- B. Interior Hose Bibbs:
1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

2.05 HYDRANTS

- A. Manufacturers:
1. Josam Company.
 2. Jay R. Smith Manufacturing Company.
 3. MIFAB, Inc.
 4. Tyler Pipe; Wade Division.
 5. Watts Drainage Products.
 6. Zurn Industries, LLC.
- B. Wall Hydrants:
1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, lockshield and removable key, and integral vacuum breaker.
- C. Post Hydrants, nonfreeze draining type:
1. ASME A112.21.3M; freeze resistant, self draining exposed-outlet post hydrant with bronze casing and casing guard, garden hose threaded outlet complying with ASME B1.20.7, loose key

operation, casing and rod of length required for burial of valve below frost line, and integral vacuum breaker.

2.06 WASHING MACHINE BOXES AND VALVES

- A. Description: Plastic preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch waste, slip in finishing cover.

2.07 REFRIGERATOR OR ICEMAKER VALVE AND RECESSED BOX

- A. Box Manufacturers:
1. Acorn Engineering Company.
 2. IPS Corporation/Water-Tite.
 3. LSP Products Group, Inc.
 4. Oatey Supply Chain Services, Inc.
 5. Viega LLC.
- B. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.08 BACKFLOW PREVENTERS

- A. Manufacturers:
1. Conbraco Industries, Inc.
 2. Watts Regulator Company, a part of Watts Water Technologies.
 3. Zurn Industries, LLC.
- B. Reduced Pressure Backflow Preventers:
1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.09 DOUBLE CHECK VALVE ASSEMBLIES

- A. Manufacturers:
1. Conbraco Industries, Inc.
 2. Watts Regulator Company, a part of Watts Water Technologies.
 3. Zurn Industries, LLC.
- B. Double Check Valve Assemblies:
1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.10 BEVERAGE-DISPENSING-EQUIPMENT BACKFLOW PREVENTERS

- A. Requirements:
1. Standard: ASSE 1022.
 2. Operation: Continuous-pressure applications.
 3. Size: NPS 1/4 or NPS 3/8.
 4. Body: Stainless Steel.
 5. End Connections: Threaded.

2.11 WATER HAMMER ARRESTORS

- A. Manufacturers:
1. AMTROL, Inc.
 2. Jay R. Smith Manufacturing Company.
 3. Josam Company.

4. MIFAB, Inc.
5. Precision Plumbing Products, Inc.
6. Sioux Chief Manufacturing Company, Inc.
7. Tyler Pipe; Wade Division.
8. Watts Regulator Company, a part of Watts Water Technologies.
9. Zurn Industries, LLC.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.12 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Manufacturers:
 - a. Conbraco Industries, Inc.
 - b. Honeywell International Inc.
 - c. Leonard Valve Company.
 - d. Powers; a division of Watts Water Technologies, Inc.
 - e. Taco Inc.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Co.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
 - a. Volume control shut-off valve on outlet.
 - b. Strainer stop checks on inlets.
 - c. Adjustable, temperature-control handle.

2.13 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Type: Y-pattern globe valve with two readout ports and memory-setting indicator. Ball type valve for balancing applications is prohibited.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.14 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.

2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
6. Drain: Factory installed, hose-end drain valve.

2.15 FLEXIBLE CONNECTORS

- A. Manufacturers:
 1. Flex-Hose Company, Inc.
 2. Flexicraft Industries.
 3. Flex Pression, Ltd.
 4. Flex-Weld Inc.
 5. Hyspan Precision Products, Inc.
 6. Mercer Gasket & Shim, Inc.
 7. Metraflex, Inc.
 8. Proco Products, Inc.
 9. TOZEN Corporation.
 10. Unaflex Universal Metal Hose; a Hyspan Company.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 1. Working Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.16 TRAP SEAL PRIMER DEVICE

- A. Manufacturers:
 1. Jay R. Smith Manufacturing Company.
 2. MIFAB, Inc.
 3. Precision Plumbing Products, Inc.
 4. Sioux Chief Manufacturing Company, Inc.
 5. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- B. Supply-Type, Trap-Seal Primer Device: ASSE 1018; 125 psig minimum pressure rating, bronze body.
 1. Inlet/Outlet Connections: NPS 1/2 threaded, union, or solder joint.
 2. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
 3. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finish.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be a source of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or systems.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- D. Install Y-pattern strainers for water on supply side of each control valve, water pressure reducing valve, solenoid valve, and pump.
- E. Install draining-type post hydrants with 1 cu.yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu.ft. of concrete block at grade.
- F. Install floor cleanouts at elevation to accommodate finished floor.
- G. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- H. Pipe relief from backflow preventer to nearest drain.
- I. Install water hammer arrestors in water piping according to PDI-WH 201.
- J. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.
- K. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

END OF SECTION

**SECTION 223000
PLUMBING EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water Heaters:
 - 1. Commercial gas fired.
 - 2. Commercial electric.
- B. Diaphragm-type compression tanks.
- C. In-line circulator pumps.
- D. Submersible sump pumps.

1.02 REFERENCE STANDARDS

- A. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less; 2019, with Errata (2020).
- B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.
- C. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 4. Provide electrical characteristics and connection requirements.
- B. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Certifications:
 - 1. Water Heaters: NSF approved.
 - 2. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1, as applicable, in addition to requirements specified elsewhere.
 - 3. Electric Water Heaters: UL listed and labeled to UL 174.
 - 4. Pressure Vessels for Heat Exchangers: ASME labeled to ASME BPVC-VIII-1.
 - 5. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
 - 6. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

1.05 WARRANTY

- A. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATERS

- A. Manufacturers:
 - 1. A.O. Smith Water Products Co.
 - 2. Bock Water Heaters, Inc.
 - 3. Bradford White Corporation.
 - 4. Lochinvar Corporation.
 - 5. Rheem Manufacturing Company.
 - 6. State Industries.
- B. Commercial Gas Fired:
 - 1. Type: Automatic, natural gas-fired, vertical storage.
 - 2. Performance: Refer to equipment schedule on the contract drawings.
 - 3. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
 - 4. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: Magnesium.
 - 5. Certified For The Following Applications:
 - a. Automatic storage water heater.
 - 6. Controls: Automatic direct immersion thermostat with temperature range adjustable minimum 175 degrees F differential, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, intermittent electronic ignition monitoring pilot and main flame, trial for re-ignition for momentary loss of flame, shutdown of pilot and main burner in "2 to 4" seconds after loss of flame, and automatic flue damper.
- C. Commercial Electric:
 - 1. Type: Factory-assembled and wired, electric, vertical storage.
 - 2. Performance: Refer to equipment schedule on the contract drawings.
 - 3. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
 - 4. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
 - 5. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: Magnesium.
 - e. Temperature and Pressure Relief Valve: ASME labeled.
 - 6. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc.
 - 2. A.O. Smith Water Products Co.

3. Honeywell International Inc.
 4. State Industries.
 5. Taco, Inc.
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

2.03 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
1. Bell & Gossett, a xylem brand.
 2. PACO Pumps; Grundfos Pumps Corp., USA.
 3. TACO Comfort Solutions.
 4. Thrush Company, Inc.
- B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.
- G. Performance: Refer to equipment schedule on the contract drawings.

2.04 SUBMERSIBLE SUMP PUMPS

- A. Type: Completely submersible, vertical, centrifugal.
- B. Casing: Cast iron pump body and oil filled motor chamber.
- C. Impeller: Hytrel (steel coated with thermoplastic polyester elastomer); open non-clog, stainless steel shaft.
- D. Bearings: Ball bearings.
- E. Accessories: Oil resistant 6 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.
- F. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.
- G. Controls: Oil-Minder Control and Pump System designed to activate the pump to remove water from elevator pits in accordance with ASME A17.1, and will provide pumping of water only, even if an oil condition is detected. Controller to be mounted in NEMA 4x weathertight corrosion resistant polycarbonate enclosure. Controller to provide local and remote alarm in the event of a high water condition or high oil condition.
- H. Performance: Refer to equipment schedule on the contract drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- C. Pumps:

1. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION

SECTION 230010
BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Mechanical demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

1.03 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.
- 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 duct shafts.
- 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 rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. XVIII. Escutcheons.

1.05 QUALITY ASSURANCE

- A. Electrical Characteristics for Mechanical Equipment: Equipment of differing electrical characteristics may be furnished provided such equipment is proposed on the "Alternate Manufacturer Evaluation

Form", subsequently approved, and connecting electrical services, circuit breakers, and conduit sizes appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 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.

1.07 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical 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 mechanical items requiring access that are concealed behind finished surfaces.

PART 2 PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 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.

2.02 JOINING MATERIALS

- A. Refer to individual Division 23 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.
 - c. 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. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. 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.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.03 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.

- d. JCM Industries.
 - e. Smith-Blair, Inc. f. Viking Johnson.
- 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
- 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve- type coupling.
- 4. XXIII. Aboveground Pressure Piping: Pipe fitting.
- B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Cascade Waterworks Mfg. Co.
 - 2. Fernco, Inc.
 - 3. Mission Rubber Company.
 - 4. Plastic Oddities, Inc.

2.04 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder- joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co. b.
 - b. Epco Sales, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full- face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Central Plastics Company.
 - c. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc..

2.05 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Co.
 - c. Pipeline Seal and Insulator, Inc.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. 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.

2.06 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch 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 water stop, 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.
 - 1. Under deck Clamp: Clamping ring with set screws.

2.07 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. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- C. Split-Plate, Stamped-Steel Type: With concealed or exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- D. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.08 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining,
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 MECHANICAL DEMOLITION

- A. Refer to Divisions 2 and 23 for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove mechanical 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.
 8. Controls to be removed and reconnected: When controls are removed form a piece of equipment and are to be reused, the removal and reconnection shall be by the controls contractor. If the original wire is not of sufficient length to make the reconnect, a new control wire shall be used. Splicing of control wires to make the connection is not allowed.
- 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.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved.
- 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. Install escutcheons for piping with fittings with penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 1. 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.
- 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 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. 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.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- R. Provide air eliminators on the Chilled and Heating water systems.
- S. Locate manual air vents on high points in piping exterior to the building
- T. Locate automatic air vent at high points in the piping and at main air handling units connections

3.03 PIPING 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.
- G. Welded Joints: Construct joints according to AWS D10.12, 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.

3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 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 mechanical 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.

3.06 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3.

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.09 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

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SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary
 - 1. Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes basic requirements for factory-installed motors.
- B. Related Sections include the following:
 - 1. Division 23 for mounting motors and vibration isolation control devices.
 - 2. Division 23 for application of motors and reference to specific motor requirements for motor-driven equipment.

1.03 DEFINITIONS

- A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.05 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Compatible with the following:
 - a. Magnetic controllers.
 - b. Multispeed controllers.
 - c. Reduced-voltage controllers.
 - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 - 3. Matched to torque and horsepower requirements of the load.
 - 4. Matched to ratings and characteristics of supply circuit and required control sequence.

PART 2 PRODUCTS**2.01 MOTOR REQUIREMENTS**

- A. Motor requirements apply to factory-installed motors except as follows:
 - 1. Different ratings, performance, or characteristics for a motor are specified in another Section.
 - 2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
 - 3. All motors are to be high efficiency type and suitable for use with a Variable Frequency Drive.

2.02 MOTOR CHARACTERISTICS

- A. All motors above 1/16 HP and below 1 HP must be Electrically Commutated Motors (ECM). Direct drive motors shall be used whenever possible.
- B. Motors 3/4 HP and Larger: Three phase.
- C. Motors smaller than 1/2 HP: Single phase.
- D. Frequency Rating: 60 Hz.

- E. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Enclosure: Open dripproof.

2.03 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficiency according to NEMA MG 1-1998 Table 12-12.
- C. Stator: Copper windings, unless otherwise indicated.
 - 1. Multispeed motors shall have separate winding for each speed.
- D. Rotor: Squirrel cage, unless otherwise indicated.
- E. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating, unless otherwise indicated.
- G. Insulation: Class F, unless otherwise indicated.
- H. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure: Cast iron for motors 7.5hp and larger; rolled steel for motors smaller than 7.5 hp.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Designed with critical vibration frequencies outside operating range of controller output.
 - 2. Temperature Rise: Matched to rating for Class B insulation.
 - 3. Insulation: Class H.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors. NEMA Standard MG 1-1993, Revision 1, Part 31, Section IV, "Definite Purpose Inverter Fed Motors", Paragraph 31.40.4.2 Voltage Spikes.
- C. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

2.05 SINGLE-PHASE MOTORS

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split-phase start, capacitor run.
 - 3. Capacitor start, capacitor run.
- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

- C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, pre-lubricated-sleeve type for other single-phase motors.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 - 2. Test interlocks and control features for proper operation.
 - 3. Verify that current in each phase is within nameplate rating.

3.02 ADJUSTING

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.03 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

END OF SECTION

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**SECTION 230519
METERS AND GAGES FOR HVAC PIPING**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary
 - 1. Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following meters and gages for mechanical systems:
 - 1. Thermometers.
 - 2. Gages.
 - 3. Test plugs.

1.03 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale, range, and location for each.
- C. Product Certificates: For each type of thermometer and gage, signed by product manufacturer.

PART 2 PRODUCTS

2.01 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. Tterice
 - 2. Weiss
 - 3. Weksler Instruments
- B. Case: Die-cast aluminum or brass, 7 inches long.
- C. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, non-reflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale Division to maximum of 1.5 percent of range.

2.02 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.03 PRESSURE GAGES

- A. Manufacturers:

1. AMETEK
 2. Ashcroft
 3. Ernst Gage Co.
 4. KOBOLD Instruments, Inc.
 5. Marsh Bellofram.
 6. Palmer - Wahl Instruments Inc.
 7. Terrice
 8. Weiss Instruments
 9. Weksler
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
 6. Pointer: Red or other dark-color metal.
 7. Window: Glass or plastic.
 8. Ring: Metal.
 9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless-steel needle type.
 2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
 3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.04 TEST PLUGS

- A. Manufacturers:
1. Flow Design, Inc.
 2. MG Piping Products Co.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.
 5. Sisco Manufacturing Co.
 6. Terrice, H. O. Co.
 7. Watts Industries, Inc.; Water Products Div.
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200° F. D. Core Inserts: One or two self-sealing rubber valves.
1. Insert material for air, water, oil, or gas service at 20 to 200°F shall be CR.
 2. Insert material for air or water service at minus 30 to plus 275° F shall be EPDM.

PART 3 EXECUTION

3.01 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
1. Inlet and outlet of each hydronic zone.
 2. Inlet and outlet of each hydronic boiler and chiller.
 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.

4. Inlet and outlet of each hydronic heat exchanger.
 5. Inlet and outlet of each hydronic heat-recovery unit.
 6. Inlet and outlet of each thermal storage tank.
- B. Provide the following temperature ranges for thermometers:
1. Domestic Hot Water: 30 to 180°F, with 2-degree scale divisions.
 2. Domestic Cold Water: 0 to 100° F, with 2-degree scale divisions.
 3. Heating Hot Water: 30 to 240° F, with 2-degree scale divisions.
 4. Condenser Water: 0 to 160° F, with 2-degree scale divisions.
 5. Chilled Water: 0 to 100° F, with 2-degree scale divisions.

3.02 GAGE APPLICATION

- A. Install pressure gages for inlet and discharge of each pressure-reducing valve.
- B. Install pressure gages at chilled- and condenser-water inlets and outlets of chillers.
- C. Install pressure gages at suction and discharge of each pump.

3.03 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.
- E. Install test plugs in tees in piping.

3.04 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

3.05 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION

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SECTION 230523
GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following general-duty valves:
 - 1. Copper-alloy ball valves.
 - 2. Ferrous-alloy butterfly valves.
 - 3. Bronze check valves.
 - 4. Gray-iron swing check valves.
 - 5. Ferrous-alloy wafer check valves.
 - 6. Spring-loaded, lift-disc check valves.
 - 7. Bronze gate valves.
 - 8. Cast-iron gate valves.
 - 9. Bronze globe valves.
 - 10. Chainwheel actuators.
- B. Related Sections include the following:
 - 1. Division 23 Section "Mechanical Identification" for valve tags and charts.
 - 2. Division 23 piping sections for specialty valves applicable to those sections only.

1.03 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. NBR: Acrylonitrile-butadiene rubber.
 - 4. PTFE: Polytetrafluoroethylene plastic.
 - 5. SWP: Steam working pressure.
 - 6. TFE: Tetrafluoroethylene plastic.

1.04 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.05 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
 - 1. Exceptions: Domestic hot- and cold-water piping valves unless referenced.
 - 2. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
 - 3. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.

4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. All ball valves for the full port with stainless steel ball unless otherwise required.
- C. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- D. Ferrous Valves: NPS 2-1/2 and larger with flanged or grooved ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- G. Valve Actuators:
1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the
 2. "Valve Installation" Article in Part 3.
 3. Gear Drive: For quarter-turn valves NPS 8 and larger.
 4. Handwheel: For valves other than quarter-turn types.
 5. Lever Handle: For quarter-turn valves NPS 6 and smaller.
- H. Extended Valve Stems: On insulated valves.
- I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Valve Grooved Ends: AWWA C606.
- K. Threaded: With threads according to ASME B1.20.1.
- L. Valve Bypass and Drain Connections: MSS SP-45.

2.02 COPPER-ALLOY BALL VALVES

- A. Manufacturers:
1. Two-Piece and Three Piece, Copper-Alloy Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Grinnell Corporation.
 - f. Hammond Valve.
 - g. Jamesbury, Inc.
 - h. Jomar International, LTD.
 - i. Milwaukee Valve Company.
 - j. Nexus Valve Specialties.
 - k. NIBCO INC.

- I. R & M Energy Systems (Borger, TX).
 - m. Red-White Valve Corp.
 - n. Watts Industries, Inc.; Water Products Div.
- B. Copper-Alloy Ball Valves, General: MSS SP-110.
- C. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full port, chrome-plated bronze ball; [PTFE or TFE] seats; and 600-psig minimum CWP rating and blowout-proof stem.
- D. Three-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full port, chrome-plated bronze ball; [PTFE or TFE] seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.03 FERROUS-ALLOY BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Single-Flange, Ferrous-Alloy Butterfly Valves:
 - a. American Valve, Inc.
 - b. Bray International, Inc.
 - c. Cooper Cameron Corp.; Cooper Cameron Valves Div.
 - d. Crane Co.; Crane Valve Group; Center Line.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Div.
 - g. Dover Corp.; Dover Resources Company; Norriseal Div.
 - h. General Signal; DeZurik Unit.
 - i. Grinnell Corporation.
 - j. Hammond Valve.
 - k. Kitz Corporation of America.
 - l. Legend Valve & Fitting, Inc.
 - m. Metraflex Co.
 - n. Milwaukee Valve Company.
 - o. Mueller Steam Specialty.
 - p. NIBCO INC.
 - q. Process Development & Control.
 - r. Red-White Valve Corp.
 - s. Techno Corp.
 - t. Tyco International, Ltd.; Tyco Valves & Controls.
 - u. Watts Industries, Inc.; Water Products Div.
 - 2. Flanged, Ferrous-Alloy Butterfly Valves:
 - a. Bray International, Inc.
 - b. Cooper Cameron Corp.; Cooper Cameron Valves Div.
 - c. Grinnell Corporation.
 - d. Mueller Steam Specialty.
 - e. Tyco International, Ltd.; Tyco Valves & Controls.
 - 3. Grooved-End, Ductile-Iron Butterfly Valves:
 - a. Central Sprinkler Co.; Central Grooved Piping Products.
 - b. Grinnell Corporation.
 - c. Hammond Valve.
 - d. McWane, Inc.; Kennedy Valve Div.
 - e. Milwaukee Valve Company.
 - f. Mueller Steam Specialty.
 - g. NIBCO INC.

- B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
- C. Single-Flange, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer- lug type with one- or two-piece stem.
- D. Flanged, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one- or two-piece stem.
- E. Grooved-End, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Ductile- iron or steel body with grooved or shouldered ends.

2.04 BRONZE CHECK VALVES

- A. Manufacturers:
 - 1. Horizontal Lift Check Valves with Metal Disc:
 - a. Cincinnati Valve Co.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Div.
 - d. Red-White Valve Corp.
 - e. Walworth Co.
 - 2. Vertical Lift Check Valves with Metal Disc:
 - a. Cincinnati Valve Co.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Red-White Valve Corp.
 - 3. Swing Check Valves with Metal Disc:
 - a. American Valve, Inc.
 - b. Cincinnati Valve Co.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Div.
 - f. Grinnell Corporation.
 - g. Hammond Valve.
 - h. Kitz Corporation of America.
 - i. Legend Valve & Fitting, Inc.
 - j. Milwaukee Valve Company.
 - k. NIBCO INC.
 - l. Powell, Wm. Co.
 - m. Red-White Valve Corp.
 - n. Walworth Co.
 - o. Watts Industries, Inc.; Water Products Div.
- B. Bronze Check Valves, General: MSS SP-80.
- C. Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with bronze disc and seat.
- D. Class 125, Bronze, Vertical Lift Check Valves: Bronze body with bronze disc and seat.
- E. Class 125, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.

2.05 GRAY-IRON SWING CHECK VALVES

- A. Manufacturers:
 - 1. Type I, Gray-Iron Swing Check Valves with Metal Seats:
 - a. Cincinnati Valve Co.
 - b. Crane Co.; Crane Valve Group; Crane Valves.

- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Div.
- e. Flomatic Valves.
- f. Grinnell Corporation.
- g. Hammond Valve.
- h. Milwaukee Valve Company.
- i. Mueller Co.
- j. NIBCO INC.
- k. Powell, Wm. Co.
- l. Red-White Valve Corp.
- m. Walworth Co.
- n. Watts Industries, Inc.; Water Products Div.
- 2. Grooved-End, Ductile-Iron Swing Check Valves:
 - a. Grinnell Corporation.
 - b. Mueller Co.
- B. Gray-Iron Swing Check Valves, General: MSS SP-71.
- C. Class 125, gray-iron, swing check valves with metal seats.
- D. 175-psig CWP Rating, Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends.

2.06 FERROUS-ALLOY WAFER CHECK VALVES

- A. Manufacturers:
 - 1. Dual-Plate, Ferrous-Alloy, Wafer-Lug Check Valves:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Gulf Valve Co.
 - c. Valve and Primer Corp.
 - 2. Dual-Plate, Ferrous-Alloy, Double-Flanged-Type Check Valves:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Gulf Valve Co.
 - c. Techno Corp.
- B. Ferrous-Alloy Wafer Check Valves, General: API 594, spring loaded.
- C. Dual-Plate, Class 125 or 150, Ferrous-Alloy, Wafer-Lug Check Valves: Single-flange body.
- D. Dual-Plate, Class 125 or 150, Ferrous-Alloy, Double-Flanged Check Valves: Flanged-end body.

2.07 SPRING-LOADED, LIFT-DISC CHECK VALVES

- A. Manufacturers:
 - 1. Wafer, Lift-Disc Check Valves:
 - a. Durabla Fluid Technology, Inc.
 - b. Flomatic Valves.
 - c. GA Industries, Inc.
 - d. Grinnell Corporation.
 - e. Hammond Valve.
 - f. Metraflex Co.
 - g. Milwaukee Valve Company.
 - h. Mueller Steam Specialty.
 - i. Multiplex Manufacturing Co.
 - j. NIBCO INC.
 - k. SSI Equipment, Inc.
 - l. Val-Matic Valve & Mfg. Corp.

- m. Valve and Primer Corp.
- B. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.
- C. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron shell with diameter made to fit within bolt circle.

2.08 BRONZE GATE VALVES

- A. Manufacturers:
 - 1. Type 1, Bronze, Nonrising-Stem Gate Valves:
 - a. American Valve, Inc.
 - b. Cincinnati Valve Co.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Div.
 - f. Grinnell Corporation.
 - g. Hammond Valve.
 - h. Kitz Corporation of America.
 - i. Legend Valve & Fitting, Inc.
 - j. Milwaukee Valve Company.
 - k. NIBCO INC.
 - l. Powell, Wm. Co.
 - m. Red-White Valve Corp.
 - n. Walworth Co.
 - o. Watts Industries, Inc.; Water Products Div.
 - 2. Type 2, Bronze, Rising-Stem, Gate Valves:
 - a. American Valve, Inc. b. Cincinnati Valve Co.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Grinnell Corporation.
 - f. Hammond Valve.
 - g. Kitz Corporation of America.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell, Wm. Co.
 - k. Red-White Valve Corp.
 - l. Walworth Co.
- B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.
- C. Class 125, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge and union-ring bonnet.
- D. Class 125, Bronze Gate Valves: Bronze body with rising stem and bronze solid or split wedge and union-ring bonnet.

2.09 CAST-IRON GATE VALVES

- A. Manufacturers:
 - 1. Cast-Iron, Nonrising-Stem Gate Valves:
 - a. Cincinnati Valve Co.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.

- d. Crane Co.; Crane Valve Group; Stockham Div.
- e. Grinnell Corporation.
- f. Hammond Valve.
- g. Kitz Corporation of America.
- h. Legend Valve & Fitting, Inc.
- i. Milwaukee Valve Company.
- j. NIBCO INC.
- k. Powell, Wm. Co.
- l. Red-White Valve Corp. m. Walworth Co.
- m. Watts Industries, Inc.; Water Products Div.
- 2. Cast-Iron, Rising-Stem Gate Valves:
 - a. Cincinnati Valve Co.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Grinnell Corporation.
 - f. Hammond Valve.
 - g. Kitz Corporation of America.
 - h. Legend Valve & Fitting, Inc.
 - i. Milwaukee Valve Company.
 - j. NIBCO INC.
 - k. Powell, Wm. Co.
 - l. Red-White Valve Corp. m. Walworth Co.
 - m. Watts Industries, Inc.; Water Products Div.
- B. Cast-Iron Gate Valves, General: MSS SP-70, Type I.
- C. Class 125, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, nonrising stem, and solid-wedge disc.
- D. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

2.10 CHAINWHEEL ACTUATORS

- A. Manufacturers:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries, Inc.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
 - 2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Throttling Service: Ball or control valves.
 - 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Chilled, Condenser, and Heating Hot Water Piping: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: Two or Three-piece, 600-psig CWP rating, copper alloy.
 - 2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
 - 3. Butterfly Valves, NPS 2-1/2 and Larger: Single-flange or Flanged, 150-psig CWP rating for dead-end service, ferrous alloy, with EPDM liner.
 - 4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
 - 5. Lift Check Valves, NPS 2 and Smaller: Class 125 or 150, horizontal or vertical, bronze.
 - 6. Swing Check Valves, NPS 2 and Smaller: Class 125 or 150, bronze.
 - 7. Swing Check Valves, NPS 2-1/2 and Larger: Class 125, gray iron.
 - 8. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
 - 9. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer-lug or double-flanged, Class 125 or 150 ferrous alloy.
 - 10. Spring-Loaded, Lift-Disc Check Valves: Class 125 or 250, cast iron.
 - 11. Gate Valves, NPS 2 and Smaller: Class 125 or 150, bronze.
 - 12. Gate Valves, NPS 2-1/2 and Larger: Class 125, NRS or OS&Y, bronze-mounted cast iron.
- D. Domestic Water Piping: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: Two or Three-piece, 600-psig CWP rating, copper alloy.
 - 2. Ball Valves, NPS 2-1/2 and Larger: Class 150 ferrous alloy.
 - 3. Butterfly Valves, NPS 2-1/2 and Larger: Single-flange or Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
 - 4. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
 - 5. Lift Check Valves, NPS 2 and Smaller: Class 125 horizontal or vertical, bronze.
 - 6. Swing Check Valves, NPS 2 and Smaller: Class 125, bronze.
 - 7. Swing Check Valves, NPS 2-1/2 and Larger: Class 125, gray iron.
 - 8. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig CWP rating.
 - 9. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer-lug or double-flanged, Class 125 or 150, ferrous alloy.
 - 10. Spring-Loaded, Lift-Disc Check Valves, NPS 2 and Smaller: Class 125 or 150.
 - 11. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Class 125, cast iron.
 - 12. Gate Valves, NPS 2 and Smaller: Class 125 or 150, bronze.
 - 13. Gate Valves, NPS 2-1/2 and Larger: Class 125 NRS or OS&Y, bronze-mounted cast iron.
- E. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.

3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 and larger: Flanged, grooved, or threaded ends.

3.03 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor.
- G. Extend chains to 60 inches above finished floor elevation.
- H. Install check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level.
 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
 3. Lift Check Valves: With stem upright and plumb.

3.04 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic Mechanical Requirements" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.05 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION

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**SECTION 230529
HANGERS AND SUPPORT FOR HVAC EQUIPMENT**

PART 1 GENERAL

1.01 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. Details of hangers and supports on the roof shall include a detail of the roofing connection requirements. Contractor shall coordinate requirements to ensure the roofing support does not void roof warranty.

1.02 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.
- B. Related Sections include the following:
 - 1. Division 23 for vibration isolation restraint devices.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 SUBMITTALS

- A. Product Data: For each Type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- B. Shop Drawings: Provide shop drawings for each location required for multiple piping supports and trapeze hangers. Provide manufacturer's catalog data including load capacity.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products from one of the following manufacturers:
 - 1. Pipe Hangers:
 - a. AAA Technology and Specialties Co., Inc.
 - b. B-Line Systems, Inc.
 - c. Grinnell Corp.
 - d. National Pipe Hanger Corp.
 - e. PHD Manufacturing, Inc.
 - 2. Channel Support Systems:
 - a. B-Line Systems, Inc.
 - b. Grinnell Corp.; Power-Strut Unit.
 - c. National Pipe Hanger Corp.
 - d. Unistrut Corp.
 - 3. Thermal-Hanger Shield Inserts:
 - a. Carpenter & Patterson, Inc.
 - b. Michigan Hanger Co., Inc.
 - c. PHS Industries, Inc.
 - d. Pipe Shields, Inc.

2.02 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
 - 1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
 - 1. Coatings: Manufacturer's standard painted or galvanized finish.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
 - 1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water- repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 - 2. Material for Hot Piping: ASTM C 552, Type I cellular glass or water- repellent-treated, ASTM C 533, Type I calcium silicate.
 - 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 - 4. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 - 5. Insert Length: Extend 2 inches beyond sheet metal shield.

2.03 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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 deg 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. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 - 6. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
 - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 - 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion- Type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 - 10. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

11. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 12. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 13. XVIII. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 14. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 ° F piping installations.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification 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. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I- beams for heavy loads.
 8. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 9. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 10. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360- degree insert of high-density, 100-psi minimum compressive- strength, water-repellent-treated calcium silicate or
 - a. cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
 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 D-1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses will not be transmitted to connected equipment.
- G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- H. Insulated Piping: Comply with the following:
 1. Install MSS SP-58, Type 39 protection saddles. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight- distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 2. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 3. Pipes NPS 8 and Larger: Include wood inserts.
 4. Insert Material: Length at least as long as protective shield.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.04 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.06 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
- C. Shop Drawings - Vibration Isolation Systems:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 - 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

1.06 QUALITY ASSURANCE

- A. Comply with applicable building code.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 - 3. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.
- D. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.
 - b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
 - c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.
 - 2. Minimum Static Deflection:
 - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
 - b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
 - 3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
 - 4. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
 - 5. Use modular seal where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.
- E. Thrust Restraint Applications:
 - 1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg or greater total static pressure.
 - 2. Minimum Static Deflection: Same as static deflection of equipment.
 - 3. Limit lateral movement to 0.25 inch or less unless otherwise indicated.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

- A. Manufacturers:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Kinetics Noise Control, Inc
 - b. Mason Industries
 - c. Vibration Eliminator Company, Inc
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration-Isolated Concrete Inertia Bases:
 - 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

2. Minimum Base Depth: 6 inches.
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 033000.
6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.
7. Pump Applications: Size and configure bases for piping elbow supports as required.

2.03 VIBRATION ISOLATORS

A. Manufacturers:

1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc
 - b. Mason Industries
 - c. Vibration Eliminator Company, Inc
 - d. Substitutions: See Section 016000 - Product Requirements.
2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.

C. Vibration Isolators for Nonseismic Applications:

1. Resilient Material Isolator Pads:
 - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) isolator material.
 - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Open (Unhoused) Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
 - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
3. Resilient Material Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection.
4. Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.

- b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 5. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- 6. Thrust Restraints:
 - a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 - 4. Thrust Restraints:
 - a. Adjust restraint movement under normal operating static pressure.
 - 5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 - 6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 - 7. Adjust isolators to be free of isolation short circuits during normal operation.
 - 8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
 - 1. Verify isolator static deflections.
 - 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

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**SECTION 230553
MECHANICAL IDENTIFICATION**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - a. Equipment markers.
 - b. Access panel and door markers.
 - c. Pipe markers.
 - d. Stencils.
 - e. Valve tags.
 - f. Valve schedules.
 - g. Warning tags.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.05 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 location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Phenolic-resin laminated with data engraved, not stamped, for permanent attachment on equipment. If equipment located above ceiling, utilize a white phenolic-resin laminated identification tag riveted to the ceiling grid or ceiling structure at that unit.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: ASTM D 709, Type I, cellulose, paper-base, phenolic- resin-laminate engraving stock; Grade ES-2. Fabricate in sizes required for message

1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4- 1/2 by 6 inches for equipment.
 4. Fasteners: Self-tapping, stainless-steel screws.
- C. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws.

2.02 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full- band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

2.03 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.
1. Stencil Material: Metal or fiberboard.
 2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel, black, unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

2.04 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2- inch numbers, with numbering scheme approved by Architect or Engineer. Provide 5/32-inch hole for fastener.
1. Material: 0.032-inch- thick brass or aluminum.
 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.05 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal- operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: 30"x42" display frame for mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Provide one each for every mechanical equipment room.
3. Frame: Extruded aluminum.
4. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.06 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: Brass grommet and wire.
 3. XVIII. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
 4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.01 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with mechanical fasteners on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
1. Letter Size: Minimum 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.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - g. Fans, blowers, primary balancing dampers, and mixing boxes.
 - h. Packaged HVAC central-station and zone-type units.
 - i. Tanks and pressure vessels.

- j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- D. Install access panel markers with screws on equipment access panels.

3.03 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 - 2. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
- B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers with painted, color-coded bands or rectangles complying with ASME A13.1 on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 non-accessible 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 markers.

3.04 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; 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 those indicated in the following:
 - 1. Valve-Tag Size, shape, and color:
 - a. 1-1/2 inches, round, natural color.

3.05 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

3.06 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.07 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.08 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

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SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.

1.02 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).
- C. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems; 2019, with Errata (2022).

1.03 SUBMITTALS

- A. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 3. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
 - 4. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - 1) Terminal flow calibration (for each terminal type).
 - 2) Diffuser proportioning.
 - 3) Branch/submain proportioning.
 - 4) Total flow calculations.
 - 5) Rechecking.
 - 6) Diversity issues.
 - g. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 - h. Procedures for formal deficiency reports, including scope, frequency and distribution.

- C. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 5. Units of Measure: Report data in I-P (inch-pound) units only.
 - 6. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- N. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.07 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.08 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Plumbing Pumps.
 - 2. HVAC Pumps.
 - 3. Forced Air Furnaces.
 - 4. Packaged Roof Top Heating/Cooling Units.
 - 5. Computer Room Air Conditioning Units.
 - 6. Air Handling Units.
 - 7. Fans.
 - 8. Air Terminal Units.

9. Air Inlets and Outlets.

3.09 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer.
 - 2. Model/Frame.
 - 3. HP/BHP.
 - 4. Phase, voltage, amperage; nameplate, actual, no load.
 - 5. RPM.
 - 6. Service factor.
 - 7. Sheave Make/Size/Bore.
- B. Pumps:
 - 1. Identification/number.
 - 2. Manufacturer.
 - 3. Size/model.
 - 4. Impeller.
 - 5. Service.
 - 6. Design flow rate, pressure drop, BHP.
 - 7. Actual flow rate, pressure drop, BHP.
 - 8. Discharge pressure.
 - 9. Suction pressure.
 - 10. Total operating head pressure.
- C. Cooling Coils:
 - 1. Identification/number.
 - 2. Location.
 - 3. Service.
 - 4. Manufacturer.
 - 5. Air flow, design and actual.
 - 6. Entering air DB temperature, design and actual.
 - 7. Entering air WB temperature, design and actual.
 - 8. Leaving air DB temperature, design and actual.
 - 9. Leaving air WB temperature, design and actual.
 - 10. Water flow, design and actual.
 - 11. Water pressure drop, design and actual.
 - 12. Entering water temperature, design and actual.
 - 13. Leaving water temperature, design and actual.
 - 14. Saturated suction temperature, design and actual.
 - 15. Air pressure drop, design and actual.
- D. Heating Coils:
 - 1. Identification/number.
 - 2. Location.
 - 3. Service.
 - 4. Manufacturer.
 - 5. Air flow, design and actual.
 - 6. Water flow, design and actual.
 - 7. Water pressure drop, design and actual.
 - 8. Entering water temperature, design and actual.
 - 9. Leaving water temperature, design and actual.
 - 10. Entering air temperature, design and actual.

11. Leaving air temperature, design and actual.
 12. Air pressure drop, design and actual.
- E. Air Moving Equipment:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Arrangement/Class/Discharge.
 6. Air flow, specified and actual.
 7. Return air flow, specified and actual.
 8. Outside air flow, specified and actual.
 9. Total static pressure (total external), specified and actual.
 10. Sheave Make/Size/Bore.
 11. Number of Belts/Make/Size.
 12. Fan RPM.
- F. Exhaust Fans:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Sheave Make/Size/Bore.
 8. Number of Belts/Make/Size.
 9. Fan RPM.
- G. Duct Traverses:
1. System zone/branch.
 2. Duct size.
 3. Area.
 4. Design velocity.
 5. Design air flow.
 6. Test velocity.
 7. Test air flow.
 8. Duct static pressure.
 9. Air temperature.
- H. Terminal Unit Data:
1. Manufacturer.
 2. Type, constant, variable, single, dual duct.
 3. Identification/number.
 4. Location.
 5. Model number.
 6. Size.
 7. Minimum static pressure.
 8. Minimum design air flow.
 9. Maximum design air flow.
 10. Maximum actual air flow.
 11. Inlet static pressure.
- I. Air Distribution Tests:

1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Design air flow.
6. Test (final) air flow.
7. Percent of design air flow.

END OF SECTION

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SECTION 230713 DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Jacketing and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- D. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2025.
- E. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers; 2015 (Reapproved 2022).
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. Johns Manville.
 - 2. Knauf Insulation.
 - 3. Owens Corning Corporation.
 - 4. Manson Insulation Inc.

- 5. CertainTeed Corporation.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K value: 0.27 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Density: 1 pound per cubic foot
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
- D. Vapor Barrier Tape:
 - 1. Manufacturers:
 - a. Avery Dennison Corp., Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Co., Inc..
 - d. Knauf Insulation.
 - e. Venture Tape.
 - 2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. Johns Manville.
 - 2. Knauf Insulation.
 - 3. Owens Corning Corporation.
 - 4. Manson Insulation Inc.
 - 5. CertainTeed Corporation.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. K Value: 0.23 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Density: 2 pounds per cubic foot
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
- D. Vapor Barrier Tape:
 - 1. Manufacturers:
 - a. Avery Dennison Corp., Specialty Tapes Division.
 - b. Compac Corporation.
 - c. Ideal Tape Company.
 - d. Knauf Insulation.
 - e. Venture Tape.
 - 2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.

2.04 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board. Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg. F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 - 1. Manufacturer:
 - a. Johns Manville; a Berkshire Hathaway Company.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Manufacturers:
 - a. 3M.
 - b. CetainTeed Corporation.
 - c. Johns Manville; a Berkshire Hathaway Company.
 - d. Nelson Firestop; a brand of Emerson Industrial Automation.
 - e. Thermal Ceramics.
 - f. Unifrax Corporation.

2.05 JACKETING AND ACCESSORIES

- A. Aluminum Jacket:
 1. Thickness: 0.016 inch sheet.
 2. Finish: Embossed.
 3. Joining: Longitudinal slip joints and 2 inch laps.
 4. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- B. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.
 1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
 2. Thickness: 34 mil, 0.034 inch.
 3. Finish: Embossed.
 4. Color: Silver.
 5. Water Vapor Transmission: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 6. Mold Resistance: Pass when tested in accordance with ASTM C1338.
 7. Emissivity: 0.30 when tested in accordance with ASTM C1371.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated Ducts Conveying Air Below Ambient Temperature:
 1. Provide insulation with vapor barrier jackets.
 2. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- D. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with aluminum jacket.
- E. Where fire rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating. Insulated duct access panels and doors to achieve same fire rating as duct.
- F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with outdoor jacket finished as specified in Section 2.05 Jackets.
- G. Slope exterior ductwork to shed water.
- H. External Duct Insulation Application:
 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.

2. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
3. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
4. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.03 SCHEDULES

- A. Exhaust Ducts Within 10 ft of Exterior Openings:
 1. Type: Mineral Fiber Blanket
 2. Thickness: 2 inch or Installed R-value of 6.0
- B. Supply, Return & Outside Air Ducts:
 1. Type: Mineral Fiber Blanket
 2. Thickness: 2 inch or Install R-value of 6.0
- C. Ducts Exposed to Outdoors:
 1. Type: Mineral Fiber Board with field applied jacket
 2. Thickness: 3" Thickness or Installed R-value of 8.0
- D. Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum:
 1. Type: Fire-rated blanket or board
 2. Thickness: As required to achieve 2-hour fire rating

END OF SECTION

**SECTION 230719
HVAC PIPING INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.
- B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
- G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, RIGID

- A. Manufacturers:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville Corporation.
 - 3. Knauf Insulation.
 - 4. Manson Insulation Inc.

- 5. Owens Corning Corporation.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Aeroflex USA, Inc.
 - 2. Armacell LLC.
 - 3. K-Flex USA LLC.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: Minus 40 degrees F.
 - 2. Maximum Service Temperature: 180 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETING AND ACCESSORIES

- A. PVC Plastic.
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
 - 2. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- D. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- E. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- F. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 078400.
- G. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- H. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.
- I. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

- A. Heating Systems:
1. Heating Water Supply and Return Indoor Applications: NPS 1-1/2 inch and smaller, preformed glass fiber, 1-1/2 inches thick; NPS 2 and larger, preformed glass fiber, 2 inches thick. Outdoor Applications: all sizes, preformed glass fiber, 2 inches thick with field applied jacket.
- B. Cooling Systems:
1. Chilled Water Indoor Applications: NPS 3/4 and larger, preformed glass fiber, 1-1/2 inches thick. Outdoor Applications: all sizes, preformed glass fiber, 2 inches thick with field applied jacket.
 2. Refrigerant Suction: all sizes, flexible elastomeric, 1 inch thick; provide 2 inches thick for outdoor applications.
 3. Refrigerant Hot Gas: all sizes, flexible elastomeric, 1 inch thick; provide 2 inches thick for outdoor applications.

END OF SECTION

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**SECTION 230800
COMMISSIONING OF HVAC**

PART 1 GENERAL

1.01 SUMMARY

- A. See Section 019113 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 019113.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
 - 1. Control system.
 - 2. Major and minor equipment items.
 - 3. Piping systems and equipment.
 - 4. Ductwork and accessories.
 - 5. Terminal units.
 - 6. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - Application of the Commissioning Process to New HVAC&R Systems; 2025.

1.03 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
 - 1. System name.
 - 2. List of devices.
 - 3. Step-by-step procedures for testing each controller after installation, including:
 - a. Process of verifying proper hardware and wiring installation.
 - b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
 - c. Process of performing operational checks of each controlled component.
 - d. Plan and process for calibrating valve and damper actuators and all sensors.
 - e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
 - 4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has "passed" and is operating within the contract parameters.
 - 5. Description of the instrumentation required for testing.

6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.
- C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
 1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
 2. Full as-built set of control drawings.
 3. Full as-built sequence of operations for each piece of equipment.
 4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
 - a. Floor.
 - b. Room number.
 - c. Room name.
 - d. Air handler unit ID.
 - e. Reference drawing number.
 - f. Air terminal unit tag ID.
 - g. Heating and/or cooling valve tag ID.
 - h. Minimum air flow rate.
 - i. Maximum air flow rate.
 5. Full print out of all schedules and set points after testing and acceptance of the system.
 6. Full as-built print out of software program.
 7. Electronic copy on disk of the entire program for this facility.
 8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
 9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
 10. Control equipment component submittals, parts lists, etc.
 11. Warranty requirements.
 12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
 13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
 - a. Sequences of operation.
 - b. Control drawings.
 - c. Points lists.
 - d. Controller and/or module data.
 - e. Thermostats and timers.
 - f. Sensors and DP switches.
 - g. Valves and valve actuators.
 - h. Dampers and damper actuators.
 - i. Program setups (software program printouts).
- E. Project Record Documents: See Section 017800 for additional requirements.
 1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.

2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- F. Draft Training Plan: In addition to requirements specified in Section 017900, include:
 1. Follow the recommendations of ASHRAE Guideline 1.1.
 2. Control system manufacturer's recommended training.
 3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- G. Training Manuals: See Section 017900 for additional requirements.
 1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.01 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
 1. Include cost of sheaves and belts that may be required for testing, adjusting, and balancing.
- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
- G. Provide temperature and pressure taps in accordance with Contract Documents.
 1. Provide a pressure/temperature plug at each water sensor that is an input point to the control system.

3.02 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.

- C. Provide two-way radios for use during the testing.
- D. Valve/Damper Stroke Setup and Check:
 - 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 - 2. Set pump/fan to normal operating mode.
 - 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 - 4. Command valve/damper open; verify position is full open and adjust output signal as required.
 - 5. Command valve/damper to a few intermediate positions.
 - 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- E. Isolation Valve or System Valve Leak Check: For valves not by coils.
 - 1. With full pressure in the system, command valve closed.
 - 2. Use an ultra-sonic flow meter to detect flow or leakage.
- F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.03 TAB COORDINATION

- A. TAB: Testing, adjusting, and balancing of HVAC.
- B. Coordinate commissioning schedule with TAB schedule.
- C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
- D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
- E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
- F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.
- C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
- D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
 - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
 - 2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
 - 1. Setpoint changing features and functions.
 - 2. Sensor calibrations.

- G. Demonstrate to the Commissioning Authority:
1. That all specified functions and features are set up, debugged and fully operable.
 2. That scheduling features are fully functional and setup, including holidays.
 3. That all graphic screens and value readouts are completed.
 4. Correct date and time setting in central computer.
 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
 6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
 7. Power failure and battery backup and power-up restart functions.
 8. Global commands features.
 9. Security and access codes.
 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
 11. O&M schedules and alarms.
 12. Occupancy sensors and controls.
 13. Fire alarm interlocks and response.
 14. All control strategies and sequences not tested during controlled equipment testing.
- H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 OPERATION AND MAINTENANCE MANUALS

- A. See Section 017800 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.06 DEMONSTRATION AND TRAINING

- A. See Section 017900 for additional requirements.
- B. Demonstrate operation and maintenance of HVAC system to Owner's personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned.
- E. TAB Review: Instruct Owner's personnel for minimum 8 hours, after completion of TAB, on the following:
1. Review final TAB report, explaining the layout and meanings of each data type.
 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.

4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 5. Other salient information that may be useful for facility operations, relative to TAB.
- F. HVAC Control System Training: Perform training in at least three phases:
1. Phase 1 - Basic Control System: Provide minimum of 8 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 - a. This training may be held on-site or at the manufacturer's facility.
 - b. If held off-site, the training may occur prior to final completion of the system installation.
 - c. For off-site training, Contractor shall pay expenses of up to two attendees.
 2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 8 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
 - a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
 - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
 - d. Every display screen, allowing time for questions.
 - e. Point database entry and modifications.
 3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 4 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.
- G. Provide the services of manufacturer representatives to assist instructors where necessary.
- H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION

SECTION 230924
FACILITY MANAGEMENT CONTROL SYSTEM (TRIDIUM)

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Section 23 00 10, apply to this Section.

1.02 SECTION INCLUDES

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Facility Management and Controls System (FMCS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. The FMCS shall be capable of total integration of the facility infrastructure systems with user access to all system data either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet. This shall include HVAC controls, energy management, alarm monitoring and all trending, and reporting functions related to normal building operations all as indicated on the drawings or elsewhere in this specification.
- B. All labor, material, equipment and software not specifically referred to herein or on the plans that are required to meet the functional intent of this specification shall be provided without additional cost to the Owner.
- C. DISD will provide reserved DHCP addresses and any other network configuration information necessary to each control contractor for the purpose of configuring each JACE on the DISD network. The controls contractor shall coordinate the IP addressed for each JACE. It shall be the responsibility of each control contractor to coordinate with DISD for network connectivity.
- D. The controls contractors shall supply, install, configure and program at least one JACE for each school. An existing JACE may be used to expand an existing system, however all existing programs, points, graphics, etc. must remain in tact. It shall be the control contractor's responsibility to determine how many JACE controllers will be required at each of the schools to limit congestion and to maintain system reliability and stability. The JACE or JACEs will be the primary operator interface for the school. All JACEs must be supplied with open licenses and be configured to work with any other Niagara JACE or AX Supervisor. Configure each JACE with all User Interface, Connectivity, and Embedded Workbench tools and licenses to allow for standalone operation as well as future integration into the DISD supervisory system. All JACEs shall also be supplied with battery backup with provisions for automatic restart and database backup in case of power failure.

Additionally, all drivers necessary and required to function with the installed control components within the scope of work for each school shall be the responsibility of the control contractor. In any case, the DISD shall maintain the right to direct contractor to modify any software license, regardless of supplier, as desired by DISD.
- E. Each building will have a network connection provided by DISD. It shall be the responsibility of the control contractor to coordinate with DISD for network connection location and requirements.

1.03 RELATED SECTIONS

- A. Section 23 00 10 - Basic Mechanical Requirements
- B. Section 23 05 93 - Air and Water Balance and System Testing
- C. Section 26 00 00 - Basic Electrical Requirements

1.04 SYSTEM DESCRIPTION

- A. The entire Facility Management and Control System (FMCS) shall be comprised of a network of interoperable, standalone digital controllers communicating on an open protocol communication network via the internet to any terminal computer with access to the DISD network.

- B. The intent of this specification is to provide a peer-to-peer networked standalone, distributed control system with the capability to integrate the BacNET technology communication protocol and to present this information using a Web Browser based Graphical User Interface.
- C. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. Systems requiring proprietary database and user interface programs shall not be acceptable.
- D. A hierarchical topology is required to assure reasonable system response items and to manage the flow and sharing of data without unduly burdening the customer's internal network. Systems employing a "flat" single tiered architecture shall not be acceptable.

1.05 NIAGARA SUPERVISOR STRUCTURE

- A. The Controls Contractor will use the existing Web Supervisor and maintain all new JACE controllers at the same Niagara revision as the Supervisor. The Supervisor shall be utilized for aggregation of the campuses within this contract and in the future for further campuses.
- B. The District Wide Supervisor shall be responsible for the following services:
 - 1. District Wide Login information such as Users, Navigation
 - 2. Graphics Files necessary for central login and navigation
 - 3. Graphics files necessary for aggregation of information from the district wide system.
 - 4. Critical alarm console for display of critical alarms from the district wide system.
 - 5. Uploaded histories, data storage and retrieval
 - 6. Automatic back-up of each Site Supervisor or JACE.
- C. For campuses where multiple JACE controllers are needed, either a Site Supervisor or a Master JACE shall be provided at each campus.
- D. The Site Supervisor, or Master JACE, shall be responsible for the following services:
 - 1. Site Login information such as Users, Navigation
 - 2. Campus-specific graphics files and user interface graphics.
 - 3. Local alarm console for display of campus specific alarms.
 - 4. Uploaded histories, data storage and retrieval of campus specific trends.
 - 5. Email service for alarm notification of critical alarms.
 - 6. Automatic back-up of each JACE at the campus
 - 7. Scheduling of equipment at the campus.
- E. For campuses where multiple JACE controllers are needed, the JACEs shall be responsible for the following services:
 - 1. Generation of alarms
 - 2. Generation of data history on monitored points.
 - 3. All DDC logic. Field controllers would still contain their associated logic.
- F. For campuses where a single JACE controller is needed, the JACE shall be responsible for the following services:
 - 1. Site Login information such as Users, Navigation
 - 2. Campus-specific graphics files and user interface graphics.
 - 3. Local alarm console for display of campus specific alarms.
 - 4. Uploaded histories, data storage and retrieval of campus specific trends.
 - 5. Email service for alarm notification of critical alarms.
 - 6. Scheduling of equipment at the campus.

1.06 DEFINITIONS AND ACRONYMS

EMCS - Energy Management Control System. The EMCS controls all of the HVAC functions as well as lighting schedules and lawn sprinkler schedules

FMCS - Facility Management Control System

TCS - Temperature Control Sensor. This is the device that controls the temperature in the space.

VFD - Variable Frequency Drive

DDC - Direct Digital Control

NLC - Network Level Controller

RWS - Remote Work Station

HMI - Human Machine Interface

ASC - Application Specific Controller

OAU - Outside Air Unit

CO2 - Carbon Dioxide

CFM - Cubic Feet per Minute

GPM - Gallons Per Minute

AHU - Air Handler

FCU - Fan Coil Unit

CHW - Chilled Water

HW - Hot Water

VAV - Variable Air Volume

ppm - Parts Per Million - A measurement of the concentration of one substance within another. In this case, it is the number of CO2 particles in a sample of one million air particles.

Adj - Adjustable - All set points are assumed to be adjustable whether specified or not. The set points specified are values that should be programmed initially but can be changed if necessary.

Building Management and Control System, Facility Management Control System, Energy Management and Control System, and Control System are to be considered the same.

Component: Any individual element of the FMCS furnished under this contract including hardware, software and materials.

Contractor: The FMCS Contractor who shall provide the Facility Management and Control System and shall be responsible for the FMCS system.

Direct Digital Control (DDC) involves the connection of microprocessor- based controllers to field level sensors and actuators. The signals received from field level instrumentation are converted from analogue to digital format so that the data can be used in software logic. Control signals are determined by software logic and they are converted from digital to analogue format so that the final control elements, e.g. relays, actuators, etc., can be adjusted.

Distributed Control: A system whereby all control processing is decentralized and independent of a central computer.

Owner: Dallas Independent School District or their appointed representative.

Furnish: Purchase and deliver to the appropriate installing Contractor, complete with every appurtenance, document, commission and warranty.

Domain: A grouping of up to 32,385 nodes that can be communicate directly with each other.

Human-Machine Interface (HMI): Human-machine interfacing allows the operator to manage, command, monitor, and program the system.

Integration: Establishing communication between two devices through the use of a gateway.

Interoperability: The ability of systems from different manufacturers and of different types to share information with each other without losing any of their independent functional capabilities and without the need for complex programming.

Network: A system of distributed control units that are linked together on a communication bus. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location.

Network Configuration Tool: The software used to configure the control network and set device configuration properties.

Operating System (OS): Software which controls the execution of computer programs and which provides scheduling, debugging, input/output controls, accounting, compilation, storage assignment, data management, and related services.

Peer-to-Peer Communication: Communication directly between devices that operate on the same communications level of a network, without intervention from any intermediary devices such as a host or server PC.

Programmable Device: A device that does not have a pre-established built in application. An application creation software tool is required for an application to be created and downloaded to the device.

Provide: Furnish, install, commission, test and warrant.

Router: A device that routes messages destined for a node on another segment sub-net or domain of the control network. The device controls message traffic based on node address and priority.

Stand-Alone Control: Refers to the digital controller performing required climate control and energy management functions without connection to another digital controller or computer. Requirements for stand-alone control are a time clock, a microprocessor, resident control programs, PID control and I/O.

Software: Generic term used for those components of the computer systems that are intangible rather than physical. The term "software" is used to refer to the programs executed by the computer systems as distinct from the physical hardware of the computer systems and encompasses any programs such as operating systems, applications programs, operating sequences and databases. The term "software" shall be interpreted to include firmware if, in the context in which it is used, the term "software" does not exclude the use of read-only memory and the use of firmware meets all of the applicable criteria detailed in these specifications.

Unitary Controller: A controller designed for a specific application and for a single piece of equipment. Examples are controllers for VAV, FCU, and Unit Ventilator.

- A. The above definitions shall apply to the words:
1. When they are in upper case, when they are in lower case and when they are capitalized.
 2. In the singular and in the plural.
 3. In all grammatical tenses.

1.07 FACILITY MANAGEMENT CONTROL SYSTEM

- A. FMCS installed under this specification shall have the following characteristics:
1. The entire Facility Management and Control System (FMCS) shall be comprised of a network of interoperable, standalone digital controllers communicating on an open protocol communication network via the internet to any terminal computer with access to the DISD network.

2. A Network Area Controller (NAC), also referred to as a JACE, shall be provided as an interface between the WAN and the field control devices.
3. The control system shall be open implementation of BacNET technology using the latest ANSI/EIA 709.1 as the communications protocol. Control sequence logic shall reside in DDC hardware in the building.
4. The hardware shall be installed such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality. In Addition programing for hardware level equipment will be deployed solely from the Niagara software environment. No other software will should be needed making the ability to program a piece of hardware from any web browser possible.
5. All necessary documentation, configuration information, configuration tools, programs, drivers, and other software shall be licensed to and otherwise remain with the district such that the district or their agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the contractor.
6. All DDC devices installed under this specification shall communicate via ANSI/EIA 709.1.
7. The automation level shall, primarily, include the DDC controllers that interface with the field sensors and final control elements.
8. Distributed Control panels (DCP).
9. Unitary Controllers (UC).
10. DCP controllers shall be freely programmable peer-to-peer controllers and shall have an I/O capability to handle major items of equipment such as air handling units, roof top units, chiller plants, heating plants, etc.
11. UC shall be application specific and shall be suitable for the monitoring and control of specific items of smaller equipment such as VAV terminal units. UC shall be BacNET certified controllers. These UC shall operate on the same network as the BacNET DCP or they shall operate on a separate network.
12. The FMCS Networks shall be BacNET IP. No other protocols shall be used.

1.08 FMCS DESCRIPTION

- A. The contractor shall provide an open, interoperable peer-to-peer networked, distributed control system using ASHRAE Standard 135, BacNET communication protocols. The system shall consist of BacNET based microprocessor-based controllers, plus instrumentation, control valves, automatic dampers when not furnished by mechanical contractor, damper operators, control devices, interface equipment, BacNET routers, BacNET communication interfaces, and other apparatus required to operate the building systems and perform functions specified. The software shall employ object-oriented technology for representing all data and control devices within the system. Adherence to industry standard ASHRAE 135, to assure interoperability between all components is required.
- B. FMCS shall have backward and forward compatibility.
- C. Systems shall be furnished and installed complete in all respects, including any and all equipment, controls, wiring, instrumentation, enclosures, labor, engineering, coordination with other trades, etc. No information given in (or omitted from) these specifications shall relieve the contractor of this absolute requirement. Include all associated electrical work except as noted. Work includes furnishing of all labor, superintendence, materials, tools, equipment and sources necessary for the complete installation or modification of the following systems as herein specified. It is the intent of these specifications that the Contractor shall furnish and install the systems complete in every respect and ready to operate. All equipment, miscellaneous items and accessories required for such installation and for the correct and convenient operation of the entire installation whether or not each such item or accessory is shown on the plans or mentioned in these specifications shall be furnished and installed.
- D. Bidder shall perform sufficient site investigations to include all requirements described in the construction documents. Bids shall include, at Bidder's discretion, costs related to site verifications for renovation projects. No additional costs shall be allowed for such items.

1.09 MISCELLANEOUS REQUIREMENTS

- A. Where drawings are provided as part of or supplement to these specifications, such drawings are inherently schematic only and not intended to convey all controls, wiring, installation, details, etc. It shall be the responsibility of the Facility Management and Control Systems (FMCS) contractor to verify that control approaches presented are appropriate for the HVAC systems involved, and that bids include all work described, specified, or otherwise necessary for a complete and functioning system.
- B. Schedule:
 - 1. Contractor acknowledges that submission of bid constitutes agreement with and conformance to the completion dates.
- C. Codes, Permits, and Fees:
 - 1. This contractor shall comply with all local, state and national codes, and shall secure and pay for all applicable costs, fees, permits, and licenses. No additional costs shall be allowed for these items.
- D. Other Conditions:
 - 1. Safety:
 - a. Execute all work with the highest regard to safety. Comply with all laws governing safety, including the "Occupational Safety and Health Standards" and the "Safety and Health Regulations for Construction", State and federal. All applicable power tools used during construction shall have current approval under an approved Equipment Grounding Program, and shall bear the tag relating such. Contractor is solely responsible for all means and methods.
 - 2. Coordination and Supervision:
 - a. Each bid shall include the necessary detail and interconnection work to coordinate his work with the work of other trades. Contractor shall keep competent supervisory personnel on the job whenever work is being performed by his trade.
 - 3. Storage of Materials:
 - a. Each Contractor shall provide temporary storage facilities suitable for equipment stored at the job site. Storage facilities shall be weatherproof and lockable as required.
 - 4. Protection of Building and Materials:
 - a. Each Contractor shall take necessary precautions to prevent damage to existing buildings and to work of other trades.
 - 5. Observations:
 - a. Site observation by Owner or Engineer is for express purpose of verifying compliance by Contractor with Contract Documents, and shall not be construed as construction supervision nor indication of approval of manner or location in which work is being performed as being safe practice or place.
 - b. Contractor is reminded that he shall also comply with all respects to the Invitation to Bid, General Conditions, Supplementary Conditions, Notice of Bidders, Instructions to Bidders, and all other governing parts of these specifications and the contract documents. These sections are included as part of the contract.
 - c. Where the term "Contractor" is used within these specifications, it shall be understood to mean an approved controls manufacturer/contractor, and facility management systems contractor.
- E. The Control System provided shall include all necessary, described, or specific elements, including but not limited to the following.
 - 1. Control Equipment:

- a. Control interfaces, sensors, input/output devices, enclosures, panels, microprocessor control units, communication equipment, relays, switches, cables, connectors, wiring, and all other control devices and items.
 - b. Computer software for central control and monitoring. All cables, connectors and installation hardware. Provide complete functional system.
 - c. Engineering, programming, coordination, supervision, calibration, installation, all associated electrical work except as noted, testing, adjustments, commissioning, warranty, training, and service.
 - d. Application Specific Controllers (ASC) shall be BacNET certified.
 - e. Programmable Controllers shall be BacNET and shall reference the DISD Standard Points List and Graphics.
- F. The entire system shall be approved and listed by Underwriters Laboratories, Inc., under UL916 for energy management systems and FCC-Part 15 Subparagraph J Class A Emissions Requirements.
- G. Equipment and Software Updates/Upgrades:
 - 1. Equipment:
 - a. All equipment, components, parts, materials, etc. provided throughout the period of Work (as governed in the Agreement) shall be fully compatible with all other equipment, etc. provided at any other time throughout the period of Work. Should updated versions of equipment be provided which are not fully compatible with earlier equipment provided, Contractor shall replace earlier equipment with the later version at no cost to the Owner. A Jace 8000 with Niagara N4 software is recommended this will allow new hard ware with the ability to upgrade within an 18 month software to full N4 once the supervisor is upgraded first to N4.
 - 2. Software:
 - a. All software upgrades applicable to system and offered by the manufacturer/contractor for this system shall be provided at no cost to the Owner throughout the period of work and warranty. This no cost upgrade shall include installation, programming, modifications to field equipment, data base revisions, training, etc. as appropriate.
- H. The Engineer shall reserve all authority regarding approval, conditional approval, or rejection of systems not fully complying with these specifications.

1.10 WARRANTY

- A. The FMCS contractor shall guarantee all workmanship and material in the installed temperature regulation system for a period of one (1) year, such guarantee dating from the date of final acceptance of the entire air conditioning system by the Architect.
- B. During the warranty period, the temperature controls contractor shall respond to calls for warranty service within eight (8) working hours. Emergency service shall be obtainable within four (4) hours of notification by the Owner. Emergency service shall be obtainable on a 24 hour basis, seven (7) days per week.
- C. The temperature control contractor's office shall be within a 60-mile radius of the job site.
- D. The Owner shall grant to the Contractor, reasonable access to the FMCS system during the warranty period.
- E. Each Contractor shall guarantee all labor and materials furnished by him for a period of one (1) year.

1.11 SERVICE

- A. All service of the system shall be furnished by the Contractor, at no cost to the Owner, for a period of one (1) year, concurrent with the warranty period specified above.

1.12 SHOP DRAWINGS

- A. Contractor shall provide one (1) electronic copy of shop drawings/submittals.

- B. The following information shall be included on the cover page for each shop drawing and equipment documentation submittal:
 - 1. Project name.
 - 2. Date.
 - 3. Submittal number and re-submittal number, as appropriate.
 - 4. Name and address of Consultant.
 - 5. Name and address of General Contractor.
 - 6. Name and address of FMCS subcontractor.
 - 7. Name and address of supplier or vendor, as appropriate.
 - 8. Name of manufacturer.
 - 9. Reference to the applicable Specification Section by name and number.
- C. Shop drawings shall be CAD generated, minimum plot size of 11 x 17 inches. Drawings shall include diagrams, mounting instructions, installation procedures, equipment details and software descriptions for all aspects of the system to be installed. At minimum, the shop drawings shall be printed out and include:
 - 1. FMCS topology schematic.
 - 2. Installation drawings and schedules.
 - 3. CCP, DCP, UC and other panel layouts, including floor plan location and interconnection drawings.
 - 4. Field instrumentation locations on floor plan drawings.
 - 5. Schematic of systems indicating instrumentation locations.
 - 6. Installation details.
 - 7. Schedule of cabling including details of proposed cable types.
 - 8. Composite drawings of all motor starter terminal strips, damper terminal strips, and interfaces to other equipment indicating all wiring by all subcontractors on the terminal strips.
 - 9. Points list showing all system objects and proposed English language object names.
 - 10. Color prints of proposed graphics with a list of points for display.
 - 11. One finalized copy on flash drive shall remain in location of master JACE controller.
 - 12. Provide exact location of installed OAT sensor.
- D. Equipment submittals shall include design, performance and installation details for all aspects of the system to be installed. At minimum, the equipment documentation submittals shall include:
 - 1. Equipment technical data sheets with mounting and installation details.
 - 2. Operator terminal specifications and data sheets.
 - 3. Details of networks/communications equipment, cabling and protocols proposed.
 - 4. Software specifications and descriptions including operating sequences.
 - 5. Field sensor and instrumentation specification sheets.
 - 6. Damper and actuator specification sheets.
 - 7. Valves and actuator specification sheets.
 - 8. Details of PID and other appropriate control algorithms.
 - 9. Training outline.
 - 10. Details of piping and/or tubing proposed.

1.13 RECORD DOCUMENTATION

- A. Provide Operators' Manuals with, at minimum, the following information:
 - 1. Detailed list of the database for all installed devices.
 - 2. Details of all data base management functions and features.
 - 3. The documentation shall include comprehensive and complete details including Neuron ID address, associated controller type, etc. as required and for the interface to the FMCS.

4. All details and descriptions shall be in a step by step format such that an Operator/ Manager would be able to undertake the respective actions solely on the basis of information provided in the manuals and drawings.
- B. Provide hardware manuals which shall include, at minimum, the following:
 1. Specifications, maintenance requirements and installation requirements for all hardware components.
 2. Record drawings and schedules of the completed installation including location of devices, mounting details, cabling details.
 3. Operating sequences and interlocks.
 4. Names and addresses of spare parts suppliers.
- C. Record drawings shall be CAD generated and shall include, at minimum, the following:
 1. Details required by the shop drawings.
 2. Final locations and point ID for each monitored and controlled device.
- D. Programming Software- The most recent version of the programming software for each type of programmable and ASC controller shall be submitted and shall be licensed to the district.
- E. Upon completion of the work, the Contractor shall provide the Owner with "record" layouts for the system. Layouts shall indicate all equipment and the function of each item shall be indicated.
- F. Operating instructions and as-built system flow diagrams and drawings shall be prepared, bound and delivered to the Owner. Each sensor, relay, switch, motor, controller, indicator (when inside panel), and item of equipment, etc., shall be identified with a number or mark identical to one which shall be tagged on each item. Large items of equipment may be identified by a suitable symbol listed in a legend on the control diagram.
- G. A backup of the station/stations is required upon job completion. As-built drawings should indicate what devices are on each communication line. Drawings should also include additional devices or communication lines that were added for the job.

1.14 WORKMANSHIP

- A. Contractor shall use only thoroughly trained and experienced workmen completely familiar with the items required and with the manufacturers recommended methods of installation. In all respects, the workmanship shall be of the highest grade, and all construction shall be done according to the best practice of the trade. Unless otherwise noted, conduit shall be concealed and installed square to the building lines. Any work not meeting these requirements shall be replaced or rebuilt without extra expense to the Owner.
- B. The Bidder/Contractor shall be manufacturer and installer and ISO 9001/ISO9002.

1.15 CONTROLS MANUFACTURERS/BIDDERS

- A. Equipment and performance are intended as a standard of quality, but not as a means of excluding other approved Manufacturers/Control Contractors.
- B. Systems offered by other manufacturers/contractors which deviate slightly from these specifications, but which do not materially deviate from quality or performance, will also be acceptable, provided:
 1. Complete written submittals of the equipment and system that the Contractor proposes to bid shall be provided ten (10) working days prior bid opening. Submittals shall include cut sheets and engineering data. Submittals of only brochures will not be accepted. Submittal shall also include basic system architecture schematic.
 2. Manufacturers other than those listed below shall demonstrate their equipment in the Dallas ISD Bond Office or in the office of the Engineer and Complete engineering data and information shall be provided ten (10) working days prior bid opening. Demonstration of the equipment may also be required for Owner's personnel.
 3. Submittals shall fully and explicit describe deviations, if any, from the specified performance.

4. Approval of such submittals by the Engineer is provided via an addendum issued not less than five (5) days prior to bid opening.
 5. The written deviations become an additional factor upon which bids may be evaluated, at the direction of the Engineer or Owner.
 6. Seven references of school work in Texas are provided.
- C. Energy Management Control Systems shall be as follows or equal and have an authorized letter of recommendation from manufacturer.
1. Distech Controls by Authorized System Integrators
- D. The Engineer and Owner shall reserve all authority regarding approval, conditional approval, or rejection of systems not fully complying with these specifications.

1.16 GRAPHICS

- A. All graphical interfaces shall use standard Tridium devices that are available with the JACE. No proprietary graphics shall be utilized on these projects unless prior written approval by Owner
- B. The graphics provided shall be part of the Control Contractor's proposal. The purchase of additional licenses or graphics shall not be required for a complete and working graphical interface including dashboard or control panels, trends, alarms, etc.
- C. A text block shall be displayed on each graphic page, labeling the brand of controller associated with the piece of equipment shown.
- D. For air handling units, a description of what building area each unit serves is to be displayed on the graphic page.
- E. The display resolution for the graphics pages is to be at minimum 1280x800.
- F. The facility layout is to display relevant room numbers and unit(s) associated with that room.

1.17 ELECTRICAL POWER PROVISIONS

- A. 24Vac and below power shall be provided by the controls contractor. 120Vac power shall be provided by the electrical contractor. DDC contractor responsible for coordination with electrical contractor for all controls related 120Vac power requirements. Power fed from the normal power circuits will be provided at the following locations:
 1. NAC panel location.
 2. VAV Box Step Down Transformers
- B. Normal power shall be provided to the UC serving fan powered terminal units via the control transformer provided with the unit.
- C. Provide the necessary low voltage power to the UC provided that will serve VAV terminal units from the power sources indicated above. Provide step down transformers within panel enclosures. Provide all necessary fuses and circuit protection devices (100 VA load per disconnect and fuse maximum).
- D. Low voltage power shall be provided to the dampers interlocked to fans via the control transformer provided with the motor starter.
- E. All components of the FMCS shall be powered from the sources above.
- F. The FMCS subcontractor shall provide any additional power that is required as part of this contract. This shall include all conduit, cabling, circuit breakers, interfaces, etc.

PART 2 PRODUCTS

2.01 MATERIALS

- A. General:
 1. All materials and equipment used shall be standard components, of regular manufacture for this application. All systems and components shall have been thoroughly tested and proven in actual use.

2. Exceptions to the specification will qualify bid as unacceptable.
- B. Control Valves:
1. Control valves shall be globe type constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials. Provide two way or three way pattern as shown on the plans.
 2. Valves with size up to and including 2-1/2" shall be "screwed". 3" and larger valves shall be "flanged" configuration.
 3. Valves larger than 4" shall be butterfly. Water control valves shall be sized for a maximum pressure drop of 5.0 psig at rated flow (except as noted).
 4. Steam control valves shall be sized for a pressure drop equal to 80% of the inlet pressure.
 5. Two-way control valves shall exhibit equal percentage characteristics. Two-position control valves shall be line size. Ball valves are acceptable for floating or two-position operation where valve size is less than 1 inch.
- C. Provide butterfly valves at the following locations:
1. Cooling tower bypass.
 2. Chiller isolation.
 3. Chilled water bypass.
- D. Butterfly valves shall meet, at minimum, the following requirements:
1. Full lugged type. Semi-lug and wafer valves are not acceptable.
 2. Valves shall be full line size.
 3. Valve body shall be one of the following:
 - a. Carbon steel.
 - b. 316 stainless steel.
 - c. Cast iron.
 - d. Nickel aluminum bronze.
 4. Disc shall be one of the following:
 - a. 316 stainless steel.
 - b. Monel.
 5. Stem shall be stainless steel.
 6. Seat shall be replaceable shall have a stainless steel, titanium, Inconel or equivalent metal retaining ring and shall be one of the following:
 - a. Polymer (PTFE)
 - b. 316 stainless steel
 - c. Resilient elastomer (EPDM)
 - d. Monel
 7. Packing shall be PTFE or equivalent.
 8. Disc pins, where required to secure shaft to disc, shall be 316 stainless steel.
- E. Valve Actuators:
1. The FMCS subcontractor shall provide electric actuators for all control valves that are furnished as part of the FMCS contract. Two way and three way control valve actuators shall meet, at minimum, the following requirements:
 2. Motor driven type.
 3. Integral self-locking gear train, mechanical travel stops and two adjustable travel limit switches with electrically isolated contacts. Gear assembly shall be made of hardened steel. No plastic components shall be acceptable.
 4. Rated for continuous duty against the maximum system operating pressure. Actuator shall have an input voltage of 24 VAC.
 5. Valves exposed to exterior elements shall be NEMA - 4 rated.

6. Sized to meet the shut-off requirements when operating at the maximum system differential pressure and with the installed system pump operating at shut-off head. Actuators shall control against system maximum working pressures.
 7. Normal and failure positions shall be as indicated in the Operating Sequences.
 8. Visual mechanical position indication, showing valve position.
 9. Equipped with an integral position potentiometer to indicate the stem position of the valve if required by the sequence of operation.
 10. Manual declutch lever to enable manual operation of the valve. It shall be possible for an operator to manually modulate valves located in mechanical rooms in the event of loss of power.
 11. Actuator shall be manufactured by Belimo or approved equal.
- F. The FMCS subcontractor shall provide electric actuators for all butterfly valves provide as part of the FMCS contract. The butterfly control valve actuators shall meet the following requirements:
1. Motor driven type.
 2. Integral self-locking gear train, mechanical travel stops and two adjustable travel limit switches with electrically isolated contacts. Gear assembly shall be made of hardened steel. No plastic components shall be acceptable.
 3. Rated for continuous duty and have an input voltage of 120 VAC.
 4. Housing shall be NEMA 4 rated. The actuator cover shall be aluminum or material of equivalent strength and have captive bolts to eliminate loss of bolts when removing the cover from the base. Materials of construction shall be non-corroding.
 5. Sized to meet the shut-off requirements when operating at the maximum system differential pressure and with the installed system pump operating at shut-off head. Actuators shall control against system maximum working pressures.
 6. Valves shall fail as in the last commanded position or as indicated in the Operating Sequences.
 7. Visual mechanical position indication, showing valve position and remote indication located in display panels.
 8. Equipped with an integral position potentiometer to indicate the stem position of the valve if required by the sequences of operation.
 9. Provide for the manual modulation (opening/closing) of the valve in the event of malfunction.
 10. Chiller Isolation shall have auxiliary contacts for electrical hardwiring to facilitate interlock of chilled water pumps with Chiller.
- G. Electronic valve actuators shall be suitable for direct-coupled mounting to the valve bonnet. Valve actuators shall be properly sized to provide sufficient torque to position the valve throughout its operating range. All valve actuators shall be spring return. Where butterfly valves are specified, double acting non-spring return actuators may be used. Unless otherwise stated, provide normally open valves for heating water applications and normally closed valves for chilled water applications.
- H. Terminal unit reheat valve actuators shall be suitable for direct-coupled mounting to the valve bonnet. Valve actuators shall be properly sized to provide sufficient torque to position the valve throughout its operating range. Non-spring return tri-state floating valve actuators may be used on terminal units where the valve is less than 1 inch.
- I. Control Air Dampers
1. Control Air dampers shall be parallel blade for two-position control and opposed blade for modulating control applications. Dampers shall be galvanized with nylon bearings. Blade edge and tip seals shall be included for all dampers. Leakage through the damper shall not exceed 20 CFM per square foot at 4" w.c. (based on a 48" x 48" test sample). Blades shall be 16-gauge minimum and 10" wide maximum and frame shall be of welded channel iron. Dampers over 48" wide shall be equipped with a jackshaft to provide sufficient force throughout the intended operating range.
- J. Damper Actuators:

1. Electronic damper actuators shall be direct-couple rotary type, suitable for mounting directly on the damper end shaft. Electronic damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range. Damper actuators used on economizer and/or outside air dampers shall be spring return.
 2. Terminal unit damper actuators shall be electric, low voltage, utilizing floating control. On single duct VAV applications, VAV box damper actuators shall be an integral part of the DDC VAV box controller.
- K. Control Panels:
1. All direct digital controllers located indoors shall be installed in NEMA 1 enclosures. All direct digital controllers located outdoors shall be installed in NEMA 3R enclosures. Enclosures shall be of suitable size to accommodate all power supplies, relays and accessories required for the application. Each enclosure shall include a perforated subpanel for direct mounting of the enclosed devices. Include matched key locks for all enclosures provided.
- L. Differential Pressure Switches (Air):
1. Provide differential pressure switches across fans and filters for status indication. Differential pressure switches shall have an adjustable setpoint from 0.05" w.c. to 2" w.c. with a switch differential that progressively increases from 0.02" w.c. at minimum to 0.8" w.c. at maximum. Switch shall be SPDT rated for 15A (non-inductive) at 277VAC.
- M. Differential Pressure Switches (Liquid):
1. Provide differential pressure switches across pumps and chillers to prove flow. Differential pressure switches shall have a 0-150 psig working differential pressure and have an adjustable setpoint from 4" w.c. to 43.5" w.c. on a fall and 5.5" w.c. to 45" w.c. on a rise.
 2. Liquid differential pressure switch enclosure shall carry a NEMA 4 rating. Switch shall be SPDT rated for 5A (inductive) at 125VAC.
- N. Float Switches:
1. Provide float switches in condensate drain pans as required by code. Float switches shall utilize a magnetically actuated dry reed switch. Float shall be constructed of seamless polypropylene. Switch shall be SPDT rated for 16A (non-inductive) at 120VAC.
- O. Smoke Detectors
1. The temperature control contractor shall be responsible for interlock wiring between duct smoke detectors and starter safety circuits.
- P. Static High Limit Controllers:
1. Discharge static high limit controllers shall be provided on all VAV AHU systems. When discharge static pressure exceeds setpoint, the supply fan shall be de-energized. Manual reset shall be required.
- Q. Static Pressure Transducers:
1. Provide static pressure transducers for monitoring supply duct static pressure. Static pressure transducers shall be 100% solid state and shall include glass on silicon, ultra-stable capacitance sensors. Each static pressure transducer shall incorporate short circuit and reverse polarity protection. Transmitter output shall be either 0-10Vdc or 4- 20mA. Static pressure transducers are to be provided in an enclosure that is suitable for duct mounting. The desired setpoint is to be in the top 50% of the transmitter's operating range.
- R. Differential Pressure Transducers (Air):
1. Provide differential pressure transducers for monitoring air system and airflow measuring station differential pressures. Differential pressure transducers shall be 100% solid state and shall include glass on silicon, ultra-stable capacitance sensors. Each differential pressure transducer shall incorporate short circuit and reverse polarity protection. Transducer output shall be either 0-10Vdc or 4- 20mA. Differential pressure transducers are to be provided in an enclosure that is

suitable for duct mounting. The desired setpoint is to be in the top 50% of the transducer's operating range.

S. Line Pressure Transducers (Liquid):

1. Provide line pressure transducers for monitoring hydronic system line pressures. Pressure transducers shall be 100% solid state and shall include diffused piezoresistive silicon wafer type sensors. Transducer output shall be either 0-10Vdc or 4-20mA. Pressure transducers shall not require additional nulling valves. Pressure transducers are to be provided in a field mounted enclosure and all wetted parts shall be constructed from materials that are suitable for operation in the measured medium. The desired setpoint is to be in the top 50% of the transducer's operating range.

T. Differential Pressure Transducers (Liquid):

1. Provide differential pressure transducers for monitoring hydronic system differential pressure. Differential pressure transducers shall be 100% solid state and shall include dual diffused piezoresistive silicon wafer type sensors. Transducer output shall be either 0- 10Vdc or 4-20mA. Differential pressure transducers shall not require additional nulling valves. Differential pressure transducers are to be provided in a field mounted enclosure and all wetted parts shall be constructed from materials that are suitable for operation in the measured medium. The desired setpoint is to be in the top 50% of the transducer's operating range.

U. Airflow Measuring Stations:

1. Where shown on the plans, provide airflow measuring stations utilizing multiple point averaging sensors for total pressure measurement and bullet-nose probes for static pressure measurement. Airflow measuring stations shall be factory assembled units with a sheet metal casing of at least 16 gauge galvanized steel. Airflow measuring stations shall be equipped with 3/8" aluminum hexagon cell straightening vanes. Pressure drop across airflow measuring station shall be less than .13" w.c. at 2000 FPM with the straightening vanes installed. Accuracy of airflow measurement shall be +/- 2% at 6000 FPM inlet velocity and +/- 0.5% at 2000 FPM inlet velocity.

V. Liquid Flow Meters:

1. Provide insertion type flow meters for monitoring system hydronic system flow. Flow meters shall be 100% solid state and shall include paddle type non-magnetic, non- photoelectric sensors. Flow meters shall be provided with "hot tap" isolation valves and all accessories for bi-directional flow. Flow meter transmitter supply voltage to be 24VAC unregulated. Flow meter output shall have either a 4-20mA or pulse output that is linear with the flow rate.

W. Current Sensing Relays:

1. Provide current switches for indication of equipment status. Amperage ratings shall be adjustable with the desired setpoint to be in the top 50% of the current relay's operating range. Current sensing relays shall incorporate trip indication LED's and shall be sized for proper operation with the equipment served.

X. Relative Humidity Sensors:

1. Relative humidity sensors shall have an accuracy of +/- 3% from 5 to 95% RH. Output signal shall be either 0-10Vdc or 4-20mA. Humidity transmitters shall be factory calibrated and require no field setting.

Y. CO2 Sensors:

1. CO2 sensors shall be space or duct mounted carbon dioxide sensors as required by the application. Space CO2 sensors shall be mounted next to space temperature sensors. The sensor shall have a range of 0-2000 ppm with an accuracy of $\pm 5\%$. The response time for the sensor shall be less than one minute. The sensor shall be capable of providing an analog signal proportional to the CO2 level sensed. The signal shall be either 0-10Vdc or 4-20mA.

Z. Temperature Sensors:

1. Duct/Well Sensors: Sensors for duct and water temperature sensing shall incorporate either RTD or Thermistor sensing devices. Sensing element accuracy shall be 0.1% over the sensor span or better. Where the element is being used for sensing mixed air or coil discharge temperatures and/or the duct cross sectional area is in excess of 14 square feet, the element shall be of the averaging type. Averaging duct sensors shall utilize a 6, 12 or 24 foot sensing element. Immersion sensors shall use matched 316 stainless steel bulb wells. All duct and immersion sensors shall be provided with conduit connection housings. Sensors shall be provided with adequate standoffs for insulation installation. No Strap on sensors are allowed.
- AA. Space Sensors:
1. Wall mounted space temperature sensor: Provide wall mounted temperature sensors for spaces as indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:
 2. White protective enclosure without temperature indication, set point indication, or reset.
 3. Location as shown on the Mechanical Drawings. No sensor shall be mounted until specific location instructions are given.
 4. 10,000 ohm at 25 ° C. (77 ° F.) thermistor.
 5. FMCS shall report the monitored temperature with an accuracy of ± 0.5 °F.
 6. For DX Rooftop Units and split systems, space sensors shall have LCD display with occupancy and setpoint override capability.
- BB. Selector Switches:
1. Selector switches shall be 2 or 3-position, knob or key type as required by the sequence of operation. Selector switches shall feature oil tight construction and be fitted with snap-fit contact blocks rated for 10A, 600VAC/DC operation. Labels shall be provided indicating switch position.
- CC. Pushbutton Switches:
1. Pushbutton switches shall be either maintained or momentary as required by the sequence of operation. Pushbutton switches shall feature oil tight construction and be fitted with snap-fit contact blocks rated for 10A, 600VAC/DC operation. Labels shall be provided indicating switch function.
- DD. Pilot Lights:
1. Pilot lights shall be furnished as required by the sequence of operation. Pilot lights shall utilize multi-colored dome lenses and replaceable LED lamps. Labels shall be provided to indicate light function.
- EE. Outside air temperature and humidity sensor: Provide outside air temperature and humidity sensors as indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:
1. Ventilated white PVC sun shield.
 2. Wall mount weather proof enclosure with conduit fitting.
 3. 10,000 ohm at 25°C. (77 ° F.) thermistor.
 4. FMCS shall report the monitored temperature with an accuracy of ± 0.5 °F.
- FF. Freeze Stat: Provide freeze stats for all air handling systems that receive untreated outside air. Freeze stats shall meet, at minimum, the following requirements
1. Minimum 20 feet vapor tension element, which shall serpentine the inlet face on all coils. Provide additional sensors, wired in series, to provide one linear foot per square foot of coil surface area
 2. Interlock to the associated fan so that the fan will shut down when HOA switch is in Hand or Auto position.
 3. Manual Reset
 4. Set point shall be adjustable in the range of, at a minimum, 32 °F to 45 °F. Provide a scale with temperature setting clearly displayed.
 5. Rated for 16 amps at 120 Vac

6. Provide suitable supports
- GG. Momentary control relays: Provide momentary control relays as indicated within the Point Schedules and sequences of operation. Relays shall meet, at minimum, the following requirements:
1. Coil ratings of 120 VAC, 50 mA or 10-30 VAC/VDC, 40 mA as suitable for the application.
 2. Provide complete isolation between the control circuit and the digital output.
 3. Located in the DCP, UC or other local enclosures.
 4. 10 amp contact rating.
 5. LED status indication.
 6. Temperature
 7. Rated for 16 amps at 120 Vac.
 8. UL approved.
- HH. Photocell: Provide ambient light level sensors as indicated within the Point Schedules. Light level sensor shall meet, at minimum, the following requirements:
1. Non-corroding and weatherproof housing with sensor shield suitable for exterior installations.
 2. 4-20 mA output proportional to the ambient light level.
 3. Accuracy at room temperature: $\pm 1\%$, 100° F. temperature: $\pm 2.5\%$.
 4. Solid-state photo diode circuitry and transducer as required.
 5. Mounted on the exterior of a North wall on the roof.
 6. Sensor reading from 0 to 750 foot candles.
 7. Temperature and humidity independent.
 8. Temperature range of 10° F to 120° F
 9. Provide an emergency shut-off control button outside each chiller plant room entrance/exit door. Button shall be mounted at 48 inches above finished floor adjacent to refrigerant leak detection alarm light. Activation of any one of the buttons shall de-energize all chillers and other electrical equipment within the chiller plant room. Button shall be manually reset.
- II. Emergency Shut-Off Button: shall be highly visible to be used to shut down equipment during emergency conditions. Contacts shall be rated for 600V at 10A AC and 2.5A DC. Button shall be red in color, 1.5 inches in diameter and require manual reset. Label shall read: "Emergency - Shut Off". Enclosure shall be made of metal and be suitable for either flush mount or surface mount as application warrants.

2.02 FMCS NETWORK

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system. The FMCS shall provide communication between the various DDC controllers over a Local Area Network (LAN) that consists of a twisted pair of 24 AWG shielded wires.
- B. The controller LAN shall be a high-speed "bus type" network over which information is transmitted in a global fashion between all nodes on the network. The controller LAN shall have the capacity to contain 64 nodes at a minimum.
- C. FMCS LAN shall meet, at minimum, the following requirements:
 1. Peer-to-peer.
 2. BacNET communication protocol
 3. Data transfer rate and data throughput as required to meet the alarm annunciation requirements.
 4. The failure of any node on the secondary LAN shall in no way affect the operation of the FMCS except to inhibit monitoring and control functions at the HMI for that node or any devices served by the failed node.
- D. The failure of any node shall not inhibit the communication between remaining nodes.
- E. Each Jace controller as initially configured shall have the capacity to add 25 percent expansion for future controls.

- F. Single HMI systems shall utilize a support node interface device to convert, buffer and filter the controller LAN data to the HMI RS-232 data port. These node interface devices shall support a local hardwired HMI. The node interface shall allow an HMI to interface to the Controller LAN at any point on the network directly or via Ethernet without having to be connected to JACE in order to communicate with the system.
- G. To ensure high throughput, data transmission shall use "packetized" communication techniques, such that dozens of "messages" are contained in each "packet". The "turnaround time" for a global point to be received by any node, including HMIs, shall be less than three seconds. The FMS shall utilize the above LAN architecture to allow all of the Control Units to share data as well as to globalize alarms. The Controller LAN shall be based upon a peer- to-peer, token passing.

2.03 NETWORK AREA CONTROLLER (NAC)

- A. Network Area Controller (NAC) shall be equal to a JACE 8000 or greater with license to handle at minimum 200 devices. The NAC shall be provided with the necessary BacNET hardware and software for complete integration and functionality. The NAC shall also be provided with all drivers, software, hardware, configuration, etc. that is necessary to integrate all legacy FMCS systems at each campus. It is the responsibility of the contractor providing the NAC to verify the legacy FMCS systems at each campus where work is occurring. If no drivers are available for a specific legacy FMCS system, the contractor shall notify the Owner and Engineer in writing.
- B. The Network Area Controller (NAC) shall provide the interface between the WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
 - 1. Calendar functions
 - 2. Scheduling
 - 3. Trending
 - 4. Alarm monitoring and routing
 - 5. Time synchronization
 - 6. Integration of BacNET controller data
 - 7. Network Management functions for all BacNET based devices
- C. The NAC must provide the following hardware features as a minimum:
 - 1. Two Ethernet Ports - 10/100 Mbps
 - 2. One RS-232 Port
 - 3. One RS-485 Port
 - 4. One BacNET Interface Port
 - 5. Provide minimum 32 gigabyte Micro SD card with each JACE for local station backup.
 - 6. The NAC must be capable of operation over a temperature range of 0 to 55°C
 - 7. The NAC must be capable of withstanding storage temperatures of between 0 and 70°C
 - 8. The NAC must be capable of operating over a humidity range of 5 to 95% RH, non- condensing
- D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
- E. The NAC shall support standard web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- F. Event Alarm Notification Actions
 - 1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - 2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via wide-area network.

3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - a. To alarm
 - b. Return to normal
 - c. To fault
4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: Critical, HVAC, Energy, etc.
5. Provide timed (schedule) routing of alarms by class, object, group, or node.
6. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

G. The following alarms shall be provided for each HVAC system type:

<u>VAV AHU ALARMS</u>	<u>ALARM CLASS</u>	<u>ANNUNCIATION</u>
FREEZE STAT ALARM	HVAC	GRAPHIC
HIGH STATIC ALARM	HVAC	GRAPHIC
SMOKE/FIRE ALARM	HVAC	GRAPHIC
LOW STATIC ALARM	HVAC	GRAPHIC
<u>CV AHU ALARMS</u>		
FREEZE STAT ALARM	HVAC	GRAPHIC
SMOKE/FIRE ALARM	HVAC	GRAPHIC
LOW MIXED AIR TEMPERATURE	HVAC	GRAPHICS
<u>CHILLER</u>		
GENERAL ALARM	CRITICAL	GRAPHIC/EMAIL
<u>PUMPS</u>		
FREEZE PROTECTION FAILURE ALARM	CRITICAL	GRAPHIC/EMAIL
<u>BOILER</u>		
GENERAL ALARM	CRITICAL	GRAPHIC/EMAIL
<u>ROOFTOP UNITS</u>		
ECONOMIZER FAILURE	HVAC	

- H. Control equipment and network failures shall be treated as alarms and annunciated.
- I. Alarms shall be annunciated in any of the following manners as defined by the user:
 1. Screen message text
 2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 3. Graphic with flashing alarm object(s)
- J. The following shall be recorded by the NAC for each alarm (at a minimum):
 1. Time and date

2. Location (building, floor, zone, office number, etc.)
 3. Equipment (air handler #, access way, etc.)
 4. Acknowledge time, date, and user who issued acknowledgement.
 5. Number of occurrences since last acknowledgement.
- K. Alarm actions may be initiated by user defined programmable objects created for that purpose.
- L. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- M. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.
- N. Provide a "query" feature to allow review of specific alarms by user defined parameters.
- O. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- P. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.04 SOFTWARE LICENSE AGREEMENT

- A. The controls contractor shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to DISD as defined by the manufacturer's license agreement, but shall protect the manufacturer's rights to disclosure of trade secrets contained within such software.
- B. The open NICS license must contain the following statements
1. accept.station.in="**"
 2. accept.station.out="**"
 3. accept.wb.in="**"
 4. accept.wb.out="**"
- C. Provide a printed copy of the license agreement as part of the submittal package.

2.05 DATA COLLECTION AND STORAGE

- A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.
- B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
1. Designating the log as interval or deviation.
 2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first- in, first-out basis.
 5. Each log shall have the ability to have its data cleared on a time- based event or by a user-defined event or action.
- C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.
- D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
- E. All log data shall be available to the user in the following data formats:
1. HTML

2. XML
 3. Plain Text
 4. Comma or tab separated values
- F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
- G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
1. Archive on time of day
 2. Archive on user-defined number of data stores in the log (buffer size)
 3. Archive when log has reached its user-defined capacity of data stores
 4. Provide ability to clear logs once archived

2.06 AUDIT LOG

- A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
1. Time and date
 2. User ID
 3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

2.07 DATABASE BACKUP AND STORAGE

- A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
- B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval
- C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.08 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Mozilla Firefox™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture- specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - b. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - c. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - d. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 - e. View logs and charts.
 - f. View and acknowledge alarms.
7. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.09 SYSTEM PROGRAMMING

- A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.
- B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.
- C. No third party licensed software shall be used. All programming of field devices will be done through the Niagara based software or tools. If necessary a standard web browser can be used to modify or program any field device.
- D. Programming Methods

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many- to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
2. Configuration of each object will be done through the object's property sheet using fill- in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on- line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.10 OBJECT LIBRARIES

- A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
- B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.
- C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.
- D. All control objects shall conform to the control objects specified in the BacNET specification.
- E. The library shall include applications or objects for the following functions, at a minimum:
 1. Scheduling Object. The schedule must conform to the schedule object as defined in the BacNET specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
 2. Calendar Object. . The calendar must conform to the calendar object as defined in the BacNET specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
 3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals.
 4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
 5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for

- energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.
- F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BacNET specification.
1. Analog Input Object - Minimum requirement is to comply with the BacNET standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
 2. Analog Output Object - Minimum requirement is to comply with the BacNET standard for data sharing.
 3. Binary Input Object - Minimum requirement is to comply with the BacNET standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.
 4. Binary Output Object - Minimum requirement is to comply with the BacNET standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BacNET Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BacNET method of contention resolution shall not be acceptable.
 5. PID Control Loop Object - Minimum requirement is to comply with the BacNET standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
 6. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
 7. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
 8. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a

- comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
9. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user- defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.
 10. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
 11. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the "contained" application that are represented on the graphical shell of this container.
- G. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:
1. BacNET devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide BacNET manufacturer- specific objects to facilitate simple integration of these devices. All network variables defined in the BacNET profile shall be supported. Information (type and function) regarding network variables not defined in the BacNET profile shall be provided by the device manufacturer.
 2. For devices not conforming to the BacNET standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.

2.11 NETWORK LEVEL CONTROLLERS (NLC)

- A. Network Level Controller (BacNET programmable nodes) shall be used for all chiller, boiler, pumps, and AHU applications on this project as well as gateway interfaces to third party monitors/controllers, if required
- B. NLCs shall be equipped with a 3120® Neuron® with co-processor or 3150® Neuron® microprocessor controller, (flash or EEPROM) memory for general data processing, power supply, network transceivers.
- C. Operating system software, custom operating sequence software and application programs shall be stored in programmable, non-volatile memory.
- D. An NLC shall operate totally stand-alone and independent of a central computer for all specified control applications. Software shall include a complete operating system (OS), communications handler, point processing, standard control algorithms, and specific control sequences.
- E. NLCs shall include a battery backed hardware calendar/clock device.

- F. NLC packaging shall be such that complete installation and checkout of field wiring can be performed prior to the installation of electronic boards. The complete NLC including power
- G. supplies, etc., wired and housed in a NEMA 1 enclosure or as required by the location and local code requirements.
- H. The NLC BacNET network interface shall be a Type 1 transceiver. A communication connection shall be provided for attaching POT to node for downloading and troubleshooting applications.
 - 1. The NLC shall provide for a RS232 PC connection.
 - 2. The NLC shall provide for a connection to a local digital display unit. Local display shall be provided if possible for all Air Handling Unit, Hot Water Plant and Chilled Water Plant controllers.
 - 3. NLCs shall include:
 - a. Network service pin.
 - b. Power On indicator light.
 - c. Network communication indicator light.
 - 4. Input/Output Requirements
 - 5. Binary Input (BI) Types Supported by the NLC:
 - a. The BI function shall accept on-off, open-close, or other change of state (two state data) indications.
 - 6. Analog inputs shall include, 0-10 Vdc, 0-20 mA, 4-20 mA, and 1800 ohm (25° C) or 10,000 ohm (25° C) thermistors. Resolution of the Analog to Digital converter shall be a minimum of 10 bits.
 - 7. NLCs shall include universal inputs that support either of the above describe inputs.
 - 8. The NLC shall accommodate both binary and true analog outputs, 0- 10Vdc. The resolution of the digital to analog converter shall be a minimum of 8 bits.
 - 9. Binary outputs shall be capable of handling maintained as well as pulsed outputs for momentary or magnetic latching circuits.
 - 10. The NLC shall accommodate expansion input/output units.
 - 11. Enclosure shall be NEMA 1.
 - 12. The NLC shall include all hardware and software required for communications with other nodes, PCs, and the OW over the BacNET LANs.
 - 13. Provide with each controller the BacNET configuration information including neuron ID address, controller configuration type, LMNL, file, etc. to integrate the controller into the FMCS.

2.12 UNITARY CONTROLLERS

- A. Unitary Controllers (UC) shall be fully programmable or applications specific controllers with pre-packaged operating sequences maintained in EEPROM or flash ROM. Customization of applications specific controllers shall be possible to the extent that variable operating parameters, such as set points, control loop parameters, control constants, and schedules shall be changeable on-line through a standard web browser requiring no extra licensed software by the operator. UC shall be on the Automation Level LAN and shall provide an interface to the field instrumentation and final control elements of the equipment.
- B. The UC shall be a node on one of the Automation LANs and shall control its own communications so that the failure of any one node shall not inhibit communications on the network between the remaining nodes.
- C. UC shall be totally independent of other LAN nodes for their monitoring and control functions.
- D. Provide each UC with a battery back-up for the protection of volatile memory for a minimum of 72 hours. Batteries shall be rated for a seven year life.
- E. Provide a software clock at each UC. The system hardware real-time clock at the DCP shall be used to synchronize all other hardware and software clocks in the FMCS. Synchronization shall take place at least once every 24 hours. The clock shall have a battery back-up of at least 72 hours.
- F. All associated applications programs shall reside at the UC.

- G. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.
- H. Provide with each controller the BacNET configuration information including neuron ID address, controller configuration type, XIF file, etc. to integrate the controller into the FMCS.

2.13 UNITARY CONTROLLER - TERMINAL UNITS

- A. Each terminal unit shall have a UC. The number and location of terminal units and air flow rates shall be as indicated on the Mechanical Drawings.
- B. The terminal unit manufacturer shall provide the following components for each fan powered terminal unit for interface and mounting of the UC:
 - 1. Primary air dampers to be controlled by the UC.
 - 2. Enclosure to house the UC and associated components or suitable mounting brackets within the terminal unit enclosure.
 - 3. Multi-point averaging type flow sensor at the primary air inlet to the terminal unit.
 - 4. 24 VAC control transformer.
 - 5. 24 VAC fan control relay interface.
 - 6. 24 VAC heater control relay interface (up to two stages).
- C. The terminal unit manufacturer shall provide the following components for each cooling only VAV terminal unit for interface and mounting of the UC:
 - 1. Primary air dampers to be controlled by the UC.
 - 2. Enclosure to house the UC and associated components or suitable mounting brackets within the terminal unit enclosure.
 - 3. Multi-point averaging type flow sensor at the primary air inlet to the terminal unit.
- D. The FMCS subcontractor shall furnish the terminal unit manufacturer the following components for factory installation for each terminal unit:
 - 1. UC.
 - 2. Damper actuator.
 - 3. Hot Water Control Valve for terminal units equipped with hot water heating coils
- E. The FMCS subcontractor shall field install the following components for each terminal unit:
 - 1. Room temperature sensor.
 - 2. Discharge Air Temperature Sensor for terminal units.
- F. Provide as part of the UC differential pressure transducers for the monitoring of the terminal unit primary air flow rate.
- G. Furnish primary damper actuators, for factory mounting, meeting the following requirements:
 - 1. Direct shaft mounting.
 - 2. Adequate torque, 35 in. lbf. Minimum, to properly operate the damper from fully open to fully closed without binding.
 - 3. Locking "V" groove or similar means to prevent slippage between actuator and shaft.
- H. The UC shall monitor and control the following parameters for fan powered terminal units:
 - 1. Space temperature.
 - 2. Primary air flow rate.
 - 3. Damper modulation.
 - 4. Heating coil stage or Hot Water Valve control.
 - 5. Fan on/off control.
 - 6. Discharge air temperature.
- I. The UC shall monitor and control the following parameters for VAV terminal units:
 - 1. Space temperature.

2. Primary air flow rate.
 3. Damper modulation.
 4. Heating coil stage or Hot Water Valve control
 5. Discharge air temperature. PID algorithms shall maintain the system operation within + or - 1.0° F. of the space temperature set points.
- J. Following the installation of the terminal unit in the ceiling space the FMCS subcontractor shall undertake the following tasks:
1. Physically connect the UC into the FMCS secondary LAN.
 2. Install all data into the UC as necessary for the correct operation of the terminal unit.
 3. Calibrate the instrumentation associated with the following monitored parameters:
 - a. Space Temperature.
 - b. Primary air flow rate sensor.
 - c. Discharge Air Temperature
 4. Verify that the UC modulates the primary air duct dampers from fully open to fully closed and vice versa within the specified time and verify either visually or by feel that the damper closes fully under UC control.
 5. Verify that each of the heating stages cycles on and off (as applicable).
 6. Verify that the UC modulates the Hot Water control valve from fully open to fully closed and vice versa.
 7. Verify that the terminal unit-UC is satisfactorily integrated into the LAN.
 8. Verify that the operating sequences are correct and that there is stable modulation of the primary air damper and staging of the heat.
 9. Assist the Air Balancing subcontractor as required for the complete commissioning, calibration and operational verification of the HVAC and terminal unit systems.

PART 3 EXECUTION

3.01 MANDATORY POINTS LIST/POINT NAMES

- A. Many monitor and control points listed may not be necessary to execute the specified sequence but are useful for future sequence modifications, building control loop tuning, energy consumption analysis, FMCS operator and O&M troubleshooting.
- B. Equipment interfaces are acceptable for providing information but each piece of equipment (including but not limited to chillers, vfd's, unitary equipment, etc.) shall have a hard wired point for start/stop. All AHU's (not including FCU's, UV's UH's, standalone or packaged DX equipment), chillers and boilers shall have upgraded relays with HOA switches.
- C. All Points added by Engineer and/or Control Contractor needed for the sequences shall be identified in the Submittals and Project Record Documents.
- D. The original database names/points must be preserved and unchanged. This is to preserve original programming and bindings. The original database names are to be displayed when a mouse cursor hovers over the graphic/display name.
- E. Graphic/display names should be consistent throughout entire buildings and jobs.
- F. All points, even if not shown, that are required to complete sequence of operations shall be provided.

	NAME	READABLE	UNITS
VAV AHU			
Occupied Command	OCC_CMD	RW	-
Chilled Water Valve	CHWV_POS	RW	%
Hot Water Valve	HWV_POS	RW	%
Outside Air Damper	OAD_POS	RW	%

Supply Air Fan Command	SAF_CMD	RW	-
Supply Air Fan Speed	SAF_SPD	RW	%
Supply Air Fan Run Indication	SAF_RI	RW	-
Supply Air Temp	SA_T	RW	°F
Return Air Temp	RA_T	RO	°F
Return Air CO ₂	RA_CO ₂	RO	ppm
Mixed Air Temp	MA_T	RO	°F
Supply Air Static Pressure	SA_PS	RO	In water
Hand-Off-Auto	HOA	RW	-
Supply Air Temp Low Setpoint	SA_T_LSP	RW	°F
Supply Air Temp High Setpoint	SA_T_HSP	RW	°F
Supply Air Static Low Pressure Setpoint	SA_PS_LSP	RW	In water
Supply Air Static High Pressure Setpoint	SA_PS_HSP	RW	In water
Supply Air High Static Switch	SA_HSS	RO	-
Temperature Low Limit Alarm	TLL_ALM	RO	-
	<u>NAME</u>	<u>READABLE</u>	<u>UNITS</u>
CO2 Setpoint	CO2_SP	RW	ppm
Outside Air Min Setpoint	OAD_MIN_POS	RW	%
Outside Air Max Setpoint	OAD_MAX_POS	RW	%
Economizer OA Lower Limit	OA_ECONO_LOW	RW	°F
Economizer OA Upper Limit	OA_ECONO_UP	RW	°F
Morning Warmup OA Enable Setpoint	MRNG_WRM_OA_	RW	°F
Morning Warmup RA Setpoint	MRNG_WRM_RA_S	RW	°F
Exhaust/Relief Fan Command	RAF_CMD	RW	-
Exhaust/Relief Fan Speed	RAF_SPD	RW	%
Exhaust/Relief Fan Run Indication	RAF_RI	RW	-
Exhaust/ Relief Damper	RAD_POS	RW	%
CHWV/HWV Freeze Protection Position	FREEZE_POS	RW	%
<u>CV AHU</u>			
Occupied Command	OCC_CMD	RW	-
Chilled Water Valve	CHWV_POS	RW	%
Hot Water Valve	HWV_POS	RW	%
Outside Air Damper	OAD_POS	RW	%
Supply Air Fan Command	SAF_CMD	RW	-
Supply Air Fan Run Indication	SAF_RI	RW	-
Supply Air Temp	SA_T	RO	°F
Room Temp	R_T	RW	°F
Return Air Temp	RA_T	RO	°F
Return Air CO ₂	RA_CO ₂	RO	ppm
Mixed Air Temp	MA_T	RO	°F
Hand-Off-Auto	HOA	RW	-
Room Temp Cooling Setpoint	R_T_CSP	RW	°F
Room Temp Heating Setpoint	R_T_H	RW	°F
Temperature Low Limit Alarm	TLL_ALM	RO	-
CO2 Setpoint	CO2_SP	RW	ppm
Outside Air Min Setpoint	OAD_MIN_POS	RW	%

Outside Air Max Setpoint	OAD_MAX_POS	RW	%
	NAME	READABLE	UNITS
Economizer OA Lower Limit	OA_ECONO_LOW	RW	°F
Economizer OA Upper Limit	OA_ECONO_UP	RW	°F
Exhaust/Relief Fan Command	RAF_CMD	RW	-
Exhaust/Relief Fan Speed	RAF_SPD	RW	%
Exhaust/Relief Fan Run Indication	RAF_RI	RW	-
Exhaust/ Relief Damper	RAD_POS	RW	%
CHWV/HWV Freeze Protection Position	FREEZE_POS	RW	%
VAV Box			
Space Temp	R	RO	°F
Effective Occupancy	nvoocpcncystal	RO	°F
Space Temp (input)	nvispacetemp	RW	°F
Occupancy Command	nviocccmd	RW	°F
Cooling Setpoint	nvisetpoint	RW	°F
Effective Setpoint	nvoeffectsetpt	RO	°F
Setpoint Offset	nvistpointoffset	RW	°F
Terminal Load	nvoterminalload	RO	%
Fan Status	nvounitstatus	RO	-
Box Flow	nvoboxflow	RO	cfm
Box Flow (input)	nviboxflow	RO	cfm
Box Flow Setpoint	nvoflowcontrol	RW	cfm
Damper Position	nvomotorposition	RO	%
Supply Air Temp	SA_T	RO	°F
RTU/DX Split System			
Discharge Air Temp	DA_T	RO	°F
Fan Status	SAF_RI	RO	-
Space Temp	SP_T	RO	°F
CHW SYS			
Occupied Command	OCC_CMD	RW	-
Chilled Water Pump 1 Run Indication	CHWP1_RI	RO	-
	NAME	READABLE	UNITS
Chiller 1 Command	CH1_CMD	RO	-
Chiller 1 Run Indication	CH1_RI	RO	-
Chilled Wtr. Supply Temp	CHWS_T	RO	°F
Chilled Wtr. Return Temp	CHWR_T	RO	°F
Chiller 1 Hand-Off-Auto	CH1_HOA	RW	-
Chiller Alarm	CH1_ALM	RO	-
OAT Enable Setpoint	OAT_Enable		
Freeze Protection Enable	FRZ_Enable		
CW SYS			

Condenser Water Pump 1 Run Indication	CWP1_RI	RO	-
Condenser Water Supply Temp	CWS_T	RO	°F
Condenser Water Return Temp	CWR_T	RO	°F
COOLING TOWER			
Cooling Tower Fan Run Indication	CTF1_RI	RO	-
STM SYS			
Occupied Command	OCC_CMD	RW	-
Boiler 1 Command	B1_CMD	RO	-
Boiler 1 Run Indication	B1_RI	RO	-
Boiler 1 Hand-Off-Auto	B1_HOA	RW	-
OAT Enable Setpoint	OAT_Enable		
Freeze Protection Enable	FRZ_Enable		
CAB UH			
Room Temp	R_T	RW	°F
Room Temp Setpoint	R_T_SP	RW	°F
Steam Valve	STMV_POS	RW	%
Supply Fan Air Command	SAF_CMD	RW	-
Supply Fan Run Indicator	SAF_RI	RW	-
	NAME	READABLE	UNITS
FCU/UV			
Setpoint	nvisetpoint	RW	°F
Setpoint Offset	nvisetpntoffset	RW	°F
Discharge Air Temp	nvodischairtemp	RO	°F
Fan Status	nvounitstatus	RO	-
Effective Occupancy	nvoeffectoccup	RO	-
Effective Setpoint	nvoeffectsetpt	RO	°F
Space Temp	nvospacetemp	RO	°F
Terminal Load	nvoterminalload	RO	%
Unit Status	nvounitstatus	RO	-
Occupancy Command	nvimanocccmd	RW	-
HW SYS			
Occupied Command	OCC_CMD	RW	-
Boiler 1	B1_CMD	RO	-
Boiler 1 Run Indication	B1_RI	RO	-
Boiler 2	B2_CMD	RO	-
Boiler 1 Run Indication	B2_RI	RO	-
Hot Water Pump 1 Command	HWP1_CMD	RO	°F
Hot Water Pump 1 Run Indication	HWP1_RI	RW	-
Hot Water Pump 2 Command	HWP2_CMD	RO	°F

Hot Water Pump 2 Run Indication	HWP2_RI	RW	-
Hot Water Supply Temp	HWS_T	RO	°F
Hot Water Supply Temp Setpoint	HWS_T_SP	RW	°F
OAT Enable Setpoint	OAT_Enable		
Freeze Protection Enable	FRZ_Enable		
Geothermal Heat Pump			
Setpoint	nvisetpoint	RW	°F
Setpoint Offset	nvisetpntoffset	RW	°F
Discharge Air Temp	nvodischairtemp	RO	°F
	NAME	READABLE	UNITS
Fan Status	nvounitstatus	RO	-
Effective Occupancy	nvoeffectoccup	RO	-
Effective Setpoint	nvoeffectsetpt	RO	°F
Space Temp	nvospacetemp	RO	°F
Terminal Load	nvoterminalload	RO	%
Unit Status	nvounitstatus	RO	-
Occupancy Command	nvimanocccmd	RW	-
Reversing Valve	nvoRevV	RO	-
Note: WSHP condenser water pumps that serve more than one WSHP to be same as condenser water pump for			

- G. The following are sequences of operations which will be accomplished by the FMCS. Coordinate with Owner in operating equipment to maximize comfort and economy. All points required to accomplish the sequences will be provided and connected to the FMCS.

3.02 SEQUENCE OF OPERATIONS, SCHEDULING AND TRENDING

- The current systems will maintain their existing sequences of operation. If the FMCS contractor decides to disband the LNS database, then any global functions must be replaced in the JACE so that all current functions are operational upon completion.
- Central Plant, Auditorium, Gymnasium, Cafeteria and Administration units are to have individual time schedules. The units for the remainder of the system are to be incorporated into one schedule.
- Temperature point trending is to take place every 15 minutes and kept in history for two weeks. Change of states, such as fans and pumps, are to be done in the same manner.

3.03 RECOMMENDED SEQUENCE OF OPERATION (ENGINEER TO EDIT "A" THROUGH "O" BELOW, AS REQUIRED)

- Sequence Of Operation - Hot Water System
 - System Off - When the system is off:
 - The hot water pumps shall be off.
 - The boiler units shall be disabled.
 - All control loops shall be disabled.
 - Initiation of System Start-Up - The system shall be started:
 - By an operator manually entered command at the FMCS.
 - Automatically when there is a requirement for the hot water at any of the AHUs after an operator defined time delay.
 - System Operation - When system start-up has been initiated, the following sequences shall be implemented:

- a. The FMCS shall enable the hot water system through boiler sequencer. Sequencer shall stage boilers as needed.
 - b. The lead boiler and boiler feed pump and lead heating water pump shall be enabled and the boiler unit shall start under control of the unit mounted control panel.
 - c. The lead heating water pump shall be modulated by its VFD to maintain the pressure setpoint at the location of the most remote heating load. The lag pump shall be enabled as required to satisfy the pressure setpoint. When both pumps are enabled, the pumps shall be modulated by their VFD to operate at the same speed and satisfy the pressure setpoint.
 - d. As required to meet the heating load, the lag boilers and boiler feed pumps shall be automatically enabled and the boilers shall start under control of the unit mounted control panel.
 - e. All boilers and heating water pumps shall be rotated as lead and lag to equalize the run time of the equipment.
 - f. Boilers and heating water pumps shall be automatically disabled in reverse of the enable sequence as dictated by heating system load requirements.
 - g. Sequencer shall provide a linear setpoint reset schedule based on outside air temperature in accordance with the following:

Outside Air Temperature	40 °F	70 °F
Hot water supply temperature setpoint	180 °F	130 °F
 - h. Setpoints - The setpoints for the system shall be determined as follows:
 - 1) The hot water supply temperature setpoint shall be initially set to 180 Deg. F.
 - i. Initiation of System Shutdown - System shutdown shall be initiated:
 - 1) By operator entered manual command.
 - 2) Automatically by the FMCS based on a time schedule basis.
 - j. Alarms - The FMCS shall generate an alarm:
 - 1) If a boiler is operating without an associate pump operating and vice versa.
 - 2) If the hot water supply temperature is outside the operator established low and high alarm limits, which shall be initially set at + of - 3 deg F around the current set point.
 - k. Failure positions - When a FMCS component failure occurs:
 - 1) Pump shall remain at the last commanded state.
 - 2) Boiler shall remain at the last commanded state.
 - 3) If any operating pump or boiler fails, the units shall be disabled and the standby pumps and/or boilers shall operate without any time delays.
- B. Sequence Of Operation - VAV Air Handling Units (With VFD) and Outside Air Economizer
1. System Off - When the system is off:
 - a. All the fans shall be off.
 - b. The heating coil valve shall be 30%.
 - c. The cooling coil valve shall be 30%.
 - d. The outside air damper shall be closed.
 - e. All control loops shall be disabled.
 2. Initiation of System Start-Up - System start-up shall be initiated:
 - a. By an operator manually entered command at the FMCS.
 - b. Automatically by the FMCS based on optimal start, night setup, time schedule, restart following a fire alarm, or restart following a power failure.
 3. Occupancy: Valid Occupancy modes shall be:
 - a. Occupied: Normal operating mode for occupied spaces or daytime operation. When the unit is in the occupied mode the unit shall maintain the discharge air temperature at the active discharge heating or cooling setpoint. The occupied mode shall be the default mode of the unit.

- b. Unoccupied: Normal operating mode for unoccupied spaces or nighttime operation. When the space temperatures in the spaces served are off the heating or cooling unoccupied temperature setpoints plus/minus an offset the unit shall start the fan and enable the primary heating or cooling capacities to maintain the discharge air temperature at the active discharge air temperature setpoint. The outside Air damper shall remain closed, unless economizing.
 - 1) Unoccupied Cooling Setpoint: 85°F
 - 2) Unoccupied Heating Setpoint: 55°F
- c. Occupied Bypass: Mode used to temporarily place the unit into the occupied operation. The Occupied Bypass mode can be enabled from the local display, via a communicated value or hardwired from the space sensor. When a space sensor is available tenants shall be able to override the unoccupied mode locally. The override shall last for a maximum of 4 hours (configurable). The tenants shall be able to cancel the override from the space sensor at any time. During the override the unit shall run in occupied mode.
- 4. Heat/Cool Mode - In standalone or auto mode the unit shall automatically determine the Heat/Cool mode by transitioning between morning warmup, cooldown or normal operation.
- 5. Cooling Operation - When the unit is in cooling mode, the unit shall maintain the discharge temperature at the active discharge cooling setpoint. Based on the unit occupancy mode, the active discharge cooling setpoint shall be:
 - a. Occupied Discharge Air Cooling Setpoint: 55°F - 59°F based on an outside air temperature reset.
 - b. Unoccupied Discharge Air Cooling Setpoint: 55°F - 59°F based on an outside air temperature reset.
- 6. The unit shall use the active discharge air temperature cooling setpoint and the discharge air temperature to determine the requested cooling capacity of the unit (0-100%). The outputs shall be controlled based on the unit configuration and the requested cooling capacity.
- 7. Heating Operation - When the unit is in heating mode or morning warmup, the unit shall maintain the discharge air temperature at the active discharge air heating setpoint. Based on the unit occupancy mode, the active heating setpoint shall be:
 - a. Occupied Discharge Air Heating Setpoint: 90°F
 - b. Unoccupied Discharge Air Heating Setpoint: 90°F
- 8. The unit shall use the active discharge air temperature heating setpoint and the discharge air temperature to determine the requested heating capacity of the unit (0-100%). The outputs shall be controlled based on the unit configuration and the requested heating capacity.
- 9. The discharge heating and cooling setpoints shall be limited by adjustable parameters in the unit to prevent them from being set too low or too high.

Setpoint	Default Value
Maximum Discharge Air Cooling Setpoint	59°F
Minimum Discharge Air Cooling Setpoint	55°F
Maximum Discharge Air Heating Setpoint	100°F
Minimum Discharge Air Heating Setpoint	85°F

- 10. Transition from Unoccupied to Occupied - When the unit transitions from unoccupied mode to the occupied mode, morning warm-up routine shall be activated.
 - a. Morning Warm-Up - When unit is occupied and return air temperature is below 65°F (adj.) or more the occupied heating setpoint and morning warm-up sequence shall be activated. During warm-up the fan shall be turned on, the outside air damper shall remain closed, and the heating capacity shall be controlled to the discharge heating setpoint. When the return air temperature reaches the morning warmup return air temperature setpoint the unit shall operate in occupied mode.

- b. Pre-Cool mode is communicated only- During Pre-Cool, the fan shall be turned on, the outside air damper shall remain closed, and the cooling capacity shall be controlled to the discharge cooling setpoint.
 - 11. VAV Supply Fan Operation: The unit shall always maintain duct static setpoint in all modes of operating with the fan on. When the fan is on the unit shall read and compare the duct static pressure input to the duct static pressure setpoint and adjust the supply fan speed accordingly. A duct static pressure reset algorithm shall be used. Static pressure must be placed down the supply duct run where pressure setpoint cannot exceed 1.2 inches w.c.
 - 12. VAV Return/Exhaust Fan Operation: The unit shall always maintain building pressure setpoint in all modes of operating with the fan on. When the fan is on the unit shall read and compare the building pressure input to the building pressure setpoint and adjust the return/exhaust fan speed accordingly. The return/exhaust fan shall be controlled to maintain a positive building pressure setpoint of .08" wg (adjustable) above atmospheric pressure.
 - 13. Hydronic Cooling Valve Control- If the unit is in the cooling mode the unit shall modulate the cooling valve to maintain the discharge air temperature at the active discharge air temperature setpoint. If the economizer function is enabled and the outside air damper is not fully open the cooling valve shall be closed. If economizer is unable to maintain discharge air setpoint, cooling valve shall open to meet cooling demand. The cooling valve shall be at 30% open if the fan is off.
 - 14. Hydronic Heating Valve Control- If the unit is in the heating mode, the unit shall modulate the hydronic heating valve to maintain the discharge air temperature at the active discharge air temperature setpoint. The heating valve shall be at 30% open if the fan is off.
 - 15. Outside Air Damper Control - During all occupied modes the outside air damper shall be controlled to the effective minimum adjustable position, unless the economizing mode is active. The outside air damper shall be closed during the unoccupied mode, morning warm- up and pre-cool modes or when the outside air temperature falls below a Low Ambient Damper Lockout Setpoint [38°F], operator adjustable. Control outside air supply rate using a carbon-dioxide based demand ventilation control strategy. The outside air and return air dampers shall modulate to provide ventilation CFM to maintain CO2 levels in the spaces. The outside air damper shall be initially set at the minimum position. The dampers shall incrementally increase/decrease to maintain CO2 levels. The FMCS shall monitor CO2 levels in the return air duct. Upon CO2 value rising above 1100 ppm, the outside air damper shall modulate open from the normal position to maintain the CO2 level at 1100 ppm. Once CO2 values fall below set point (1100 ppm), the outside air CFM shall return to its minimum position.
 - 16. Economizer Control - The unit shall allow economizer during all occupied and unoccupied modes. The modulating outdoor air damper shall provide the first source of cooling. The unit shall enable economizer mode if the outside air temperature is between 55°F- 65°F, operator configurable. If economizer is initiated, the unit shall modulate the outside air damper between the active minimum position and fully open and shall modulate the mixed air damper between fully open and fully closed to maintain the discharge air temperature at the active discharge air temperature setpoint. If a hardwired outdoor air temperature sensor or a communicated value is not present, economizing shall not be allowed.
 - 17. Exhaust Air Control - The unit shall coordinate the exhaust function with the return fan and mixed air damper. The exhaust output shall be energized whenever the supply fan is on and the outdoor air damper open beyond the exhaust fan/damper enable setpoint [30%], operator configurable. The exhaust output shall remain energized until the outdoor air damper closes to below 10% (adjustable) of the exhaust damper enable setpoint and or the supply fan is turned off.
- C. Sequence of Operation - Constant Volume Air Handling Unit (Heating/ Cooling) with Outside Air Economizer
- 1. System Off - When the system is off:
 - a. All the fans shall be off.

- b. The heating coil valve shall be 30%.
 - c. The cooling coil valve shall be 30%.
 - d. The outside air damper shall be closed.
 - e. All control loops shall be disabled.
2. Initiation of System Start-Up - System start-up shall be initiated:
 - a. By an operator manually entered command at the FMCSFMCS.
 - b. Automatically by the FMCS based on optimal start, night setup, time schedule, restart following a fire alarm, or restart following a power failure.
3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
 - a. The supply air fan shall start.
 - b. The heating coil valve shall be controlled to maintain the heating space temperature setpoint.
 - c. The cooling coil valve shall be controlled to maintain the cooling space temperature setpoint.
4. Return/Exhaust Fan Operation: The unit shall always maintain space pressure setpoint in all modes of operating with the fan on. When the fan is on the unit shall read and compare the space pressure input to the space pressure setpoint and adjust the return/exhaust fan speed accordingly. The return/exhaust fan shall be controlled to maintain a positive building pressure setpoint of .08" wg (adjustable) above atmospheric pressure.
5. Outside Air Damper Control - During all occupied modes the outside air damper shall be controlled to the effective minimum adjustable position, unless the economizing mode is active. The outside air damper shall be closed during the unoccupied mode, morning warm- up and pre-cool modes or when the outside air temperature falls below a Low Ambient Damper Lockout Setpoint [38°F], operator adjustable. Control outside air supply rate using a carbon-dioxide based demand ventilation control strategy. The outside air and return air dampers shall modulate to provide ventilation CFM to maintain CO2 levels in the spaces. The outside air damper shall be initially set at the minimum position. The dampers shall incrementally increase/decrease to maintain CO2 levels. The FMCS shall monitor CO2 levels in the return air duct. Upon CO2 value rising above 1100 ppm, the outside air damper shall modulate open from the normal position to maintain the CO2 level at 1100 ppm. Once CO2 values fall below set point (1100 ppm), the outside air CFM shall return to its minimum position.
6. Economizer Control - The unit shall allow economizing during all occupied and unoccupied modes. The modulating outdoor air damper shall provide the first source of cooling. The unit shall enable economizer mode if the outside air temperature is between 55°F- 65°F, operator configurable. If economizer is initiated, the unit shall modulate the outside air damper between the active minimum position and fully open and shall modulate the mixed air damper between fully open and fully closed to maintain the discharge air temperature at the active discharge air temperature setpoint. If a hardwired outdoor air temperature sensor or a communicated value is not present, economizing shall not be allowed.
7. Exhaust Air Control - The unit shall coordinate the exhaust function with the return fan and mixed air damper. The exhaust output shall be energized whenever the supply fan is on and the outdoor air damper open beyond the exhaust fan/damper enable setpoint [30%], operator configurable. The exhaust output shall remain energized until the outdoor air damper closes to below 10% (adjustable) of the exhaust damper enable setpoint and or the supply fan is turned off.
8. Setpoints - The system shall have the following setpoints:
 - a. Space temperature setpoint shall be 70 Deg. F. for heating and 74 °F for cooling.
 - b. Freezestat setpoint shall be set at the device for 35 Deg. F.
9. Initiation of System Shutdown - System shutdown shall be initiated:
 - a. By operator entered manual command.

- b. Automatically by the FMCS base on time schedule or optimal stop.
 - c. By the fire alarm system. The FMCS shall automatically set the control relay to the off state.
- D. Sequence of Operation - Single Zone Packaged DX Rooftop Units And Split Systems (All Sizes)
 - 1. Unit shall have a sensor with LCD display capable of occupancy and setpoint override. Controller must be able to notify owner that economizer mode has failed.
- E. Sequence of Operation - Variable Air Volume Box With Supplemental Heat
 - 1. System Off - When the system is off:
 - a. The heating coil valve shall be closed.
 - b. All control loops shall be disabled.
 - 2. Initiation of System Start-Up - System start-up shall be initiated:
 - a. By an operator manually entered command at the FMCS/FMCS.
 - b. Automatically by the FMCS based on optimal start, night setup, time schedule, restart following a fire alarm, or restart following a power failure.
 - c. By Occupied Bypass: Mode used to temporarily place the unit into the occupied operation. The Occupied Bypass mode can be enabled from the local display, via a communicated value or hardwired from the space sensor. When a space sensor is available tenants shall be able to override the unoccupied mode locally. The override shall last for a maximum of 4 hours (configurable). The tenants shall be able to cancel the override from the space sensor at any time. During the override the unit shall run in occupied mode.
 - 3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
 - a. The supply air damper and heating coil valve shall be controlled to maintain the space temperature setpoint.
 - 4. Setpoints - The system shall have the following setpoints:
 - a. Space temperature setpoint shall be 70 °F for heating and 74 °F for cooling.
 - 5. Initiation of System Shutdown - System shutdown shall be initiated:
 - a. By operator entered manual command.
 - b. Automatically by the FMCS base on time schedule or optimal stop.
- F. Sequence Of Operation - Freeze Protection
 - 1. Chilled Water System: When outside air temperature is below 35 °F (adjustable setpoint). The chilled water pump will start and run continuously through a District installed device (standalone
 - 2. Mechanical thermostat). If the District installed device is not present then the FMCS Contractor shall enable the chilled water pump when the temperature is below 35°F. The FMCS Contractor shall open all chilled water valves to 30%. All valves must FAIL OPEN with loss of controller power.
 - 3. Hot Water Heating System: When outside air temperature is below 38 °F (adjustable setpoint), the hot water system will be enabled to Occupied or Night Setback mode outside of normal time schedule.
 - 4. The hot water system will transfer to occupied heating mode during regular time schedule regardless if outside air temperature is below or above the 38 °F adjustable set point. The FMCS Contractor shall open all hot water or steam valves to 30%. All valves must FAIL OPEN with loss of controller power.
- G. Sequence of Operation - Relief Fans
 - 1. Each relief fan shall be controlled by the FMCS to maintain a positive building pressure setpoint of .08" wg (adjustable) above atmospheric pressure.
- H. Sequence of Operation - Electrical Room Exhaust Fans
 - 1. Electrical room exhaust fan shall be on when temperature inside the electrical room is above 80 °F.

- I. Sequence of Operation - Crawl Space Ventilation Fans
 - 1. Each crawl space supply and/or exhaust fan shall be on and run continuously when enthalpy is above 30 BTU/lb, operator adjustable.
- J. Sequence of Operation - Restroom Exhaust Fans
 - 1. Each restroom exhaust fan will be controlled by a motion sensor. A keyed override switch will also be provided. These exhaust fans are not integrated into the FMCS.
- K. Sequence of Operation - Science Lab Exhaust Fans
 - 1. The lab's Master Shut-Off Control Unit will turn the exhaust fan off. These exhaust fans are not integrated into the FMCS.
- L. Sequence of Operation - Science Lab Prep Room Exhaust Fans
 - 1. Each Science Lab Prep Room exhaust fan will run continuously. These exhaust fans are not integrated into the FMCS.
- M. Software Interfaces Between The FMCS And Other Systems
 - 1. All equipment with interface capabilities shall be equipped with a hardwired point for start/stop through a relay.
 - a. Provide a software interface to the chillers for monitoring purposes only. Chiller enable shall be accomplished through a hardwired point through a relay. Provide a BacNET interface between the FMCS and the chiller controller units. Monitor up to 30 points per interface and make available for display on graphics through a FMCS matrix.
 - b. Provide a software interface to Variable Frequency Drives on pumps for monitoring purposes only. VFDs shall be hardwired for start/stop, run indication, speed command and alarm. Start/stop shall be hardwired through a relay. Monitor up to 10 additional points per interface and make available for display on graphics through a FMCS matrix.
- N. Sequence of Operation - Single Zone, Chilled Water/ Hot Water Central Station Variable Air Volume Air Handling Unit
 - 1. System Off - When the system is off:
 - a. All the fans shall be off.
 - b. The heating coil valve shall be 30%.
 - c. The cooling coil valve shall be 30%.
 - d. The outside air damper shall be closed.
 - e. All control loops shall be disabled.
 - 2. Initiation of System Start-Up - System start-up shall be initiated:
 - a. By an operator manually entered command at the FMCS/FMCS.
 - b. Automatically by the FMCS based on optimal start, night setup, time schedule, restart following a fire alarm, or restart following a power failure.
 - 3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
 - a. The supply air fan shall start.
 - b. The heating coil valve shall be controlled to maintain the heating space temperature setpoint.
 - c. The cooling coil valve shall be controlled to maintain the cooling space temperature setpoint.
 - 4. Return/Exhaust Fan Operation: The unit shall always maintain space pressure setpoint in all modes of operating with the fan on. When the fan is on the unit shall read and compare the space pressure input to the space pressure setpoint and adjust the return/exhaust fan speed accordingly. The return/exhaust fan shall be controlled to maintain a positive building pressure setpoint of .08" wg (adjustable) above atmospheric pressure.
 - 5. Outside Air Damper Control - During all occupied modes the outside air damper shall be controlled to the effective minimum adjustable position, unless the economizing mode is active.

- The outside air damper shall be closed during the unoccupied mode, morning warm-up and pre-cool modes or when the outside air temperature falls below a Low Ambient Damper Lockout Setpoint [38°F], operator adjustable. Control outside air supply rate using a carbon-dioxide based demand ventilation control strategy. The outside air and return air dampers shall modulate to provide ventilation CFM to maintain CO2 levels in the spaces. The outside air damper shall be initially set at the minimum position. The dampers shall incrementally increase/decrease to maintain CO2 levels. The FMCS shall monitor CO2 levels in the return air duct. Upon CO2 value rising above 1100 ppm, the outside air damper shall modulate open from the normal position to maintain the CO2 level at 1100 ppm. Once CO2 values fall below set point (1100 ppm), the outside air CFM shall return to its minimum position.
6. Economizer Control - The unit shall allow economizing during all occupied and unoccupied modes. The modulating outdoor air damper shall provide the first source of cooling. The unit shall enable economizer mode if the outside air temperature is between 55°F- 65°F, operator configurable. If economizer is initiated, the unit shall modulate the outside air damper between the active minimum position and fully open and shall modulate the mixed air damper between fully open and fully closed to maintain the discharge air temperature at the active discharge air temperature setpoint. If a hardwired outdoor air temperature sensor or a communicated value is not present, economizing shall not be allowed.
 7. Exhaust Air Control - The unit shall coordinate the exhaust function with the return fan and mixed air damper. The exhaust output shall be energized whenever the supply fan is on and the outdoor air damper open beyond the exhaust fan/damper enable setpoint [30%], operator configurable. The exhaust output shall remain energized until the outdoor air damper closes to below 10% (adjustable) of the exhaust damper enable setpoint and or the supply fan is turned off.
 8. Setpoints - The system shall have the following setpoints:
 - a. Space temperature setpoint shall be 70 °F for heating and 74 °F for cooling.
 - b. Freezestat setpoint shall be set at the device for 35 °F.
 9. Initiation of System Shutdown - System shutdown shall be initiated:
 - a. By operator entered manual command.
 - b. Automatically by the FMCS base on time schedule or optimal stop.
 - c. By the fire alarm system. The FMCS shall automatically set the control relay to the off state.
 10. Temperature Control:
 - a. Warm-up Mode: The EMCS shall determine the required warm-up period based on the optimized start algorithm. When the unit is indexed to this mode, the unit fan shall run full speed, the hot water coil shall be modulated to maintain a supply air temperature of 90°F (adj.), the chilled water valves shall be closed to their coils, the return air damper shall be open to the return air and the outside air dampers shall be closed to the outside air. Once the space set point has been reached, the EMCS shall switch the unit to the occupied mode.
 - b. Cool-down Mode: The EMCS shall determine the required cool-down period based on the optimized start algorithm. When the unit is indexed to this mode, the unit fan shall run full speed, the chilled water valves shall be open to their coils, and the return air damper shall be open to the return air and the outside air dampers shall be closed to the outside air. Once the set point has been reached, the EMCS shall switch to the occupied mode.
 - c. Occupied Heating: The EMCS shall index the unit to the occupied mode based on the programmed occupancy schedule. During this mode, the unit supply air fan shall run full speed and the outside and return air dampers shall be positioned to their respective positions to maintain CO2 levels. The hot water coil shall modulate to maintain a leaving air temperature of 90°F (adj.).
 - d. Occupied Cooling: The EMCS shall index the unit to the occupied mode based on the programmed occupancy schedule. During this mode, the unit supply air fan shall run

continuously and the outside and return air dampers shall index to their respective positions to maintain CO2 levels. Whenever the supply air temperature rises above the set point of 55°F (adj.), the EMCS shall modulate the chilled water cooling coil valve open to the coil. As the supply temperature approaches the set point, the EMCS shall modulate the chilled water valve to maintain the set point supply air temperature. The variable frequency drive shall modulate fan speed to maintain space temperature set point. The variable frequency drive shall modulate between minimum and maximum CFM, with the minimum fan speed operating at 20Hz.

- e. Unoccupied Mode: The EMCS shall index the unit to the unoccupied mode based on the programmed occupancy schedule. During this mode, the unit outside air damper shall be fully closed and the supply fan shall cycle with the units heating and cooling modes. The DDC controller shall enable the heating or cooling as required to maintain the unoccupied heating and cooling set points of 55°F and 85°F, respectively. Upon a rise in space temperature above the unoccupied cooling set point, the supply air fan and the chilled water valve shall modulate to maintain the unoccupied space set point. On a drop in space temperature below the unoccupied heating set point, the supply air fan and hot water coil shall modulate to maintain the unoccupied space set point.
 - f. Freeze Protection: When fan is off, all valves are to be at 30%.
- O. Sequence Of Operation - Water Cooled Chillers With Standalone Cooling Tower Control
- 1. System Off - When the system is off:
 - a. The chiller and condenser water pumps shall be OFF
 - b. The chillers shall be disabled.
 - c. The chiller isolation valves shall be closed.
 - d. All control loops shall be disabled.
 - 2. Initiation of System Start-Up - System start-up will be initiated by any of the following conditions:
 - a. By a FMCSFMCS operator manually entered command or FMCSFMCS Time Schedule.
 - b. Automatically by the FMCS based on time schedule and OAT adjustable setpoint integrated with FMCSFMCS.
 - 3. System Start-Up - When system start-up has been initiated, the following sequences will be implemented:
 - a. The lead and lag chiller shall be selected by one of the following operator selectable methods:
 - 1) Operator selection of individual equipment.
 - 2) Run times to equalize equipment operations.
 - 3) FMCS lead and lag programming will determine which chiller to enable.
 - b. The chilled water isolation valve and condenser water isolation valve associated with the selected lead chiller shall open fully. Opening and closing valves shall be controlled by the selected chiller. The valve actuators shall be modulating type to provide slow opening and closing action.
 - c. Once flow has been proven through then the chiller shall start under control of its unit mounted controller.
 - d. The FMCS will enable second chiller based on Delta Temperature (DT) between chill water supply and chilled water return temperatures and lead chiller has been running for minimum of 45 minutes. Initial setting of DT setpoint will be 5 degrees.
 - e. The lag chiller water isolation valve and condenser water isolation valve associated with the lag chiller shall open fully. Opening and closing of valves shall be controlled by the selected chiller. The valve actuators shall be modulating type to provide slow opening and closing action.
 - f. The lag chiller shall start and run until DT is below the 5 degree DT setpoint the FMCS will disable the lag chiller, lag chiller will then stop controlling the associated valves and close.

The FMCS shall provide adjustable off time of lag chiller operation. Initial setting of minimum OFF time is 60 minutes shall be set. The above sequence shall continue as needed for additional staging of chillers. The above sequence shall continue as needed for staging OFF of chillers.

- g. Emergency Plant Shutdown Button (EPSB) will be hardwired in series with chiller enable point from FMCS. If the emergency plant shutdown button is activated, provide for an orderly shutdown of all the equipment within the central plant. Coordinate shutdown sequence of chillers with the chiller manufacturer.
4. Setpoints - The setpoints for the system shall be determine as follows:
 - a. The chilled water supply temperature setpoint shall be set initially at 44 Deg. F and controlled by chiller.
5. Initiation of System Shutdown - System shutdown shall be initiated:
 - a. By FMCS/FMCS operator entered manual command or Time Schedule.
 - b. Automatically by the FMCS/FMCS based on time schedule basis.
 - c. Local emergency power shut off switch is activated.
6. Alarm
 - a. Chiller Alarm
7. Failure positions - When a BMCS component or power failure occurs:
 - a. Pump(s) shall remain at the last commanded state.
 - b. Chiller shall remain at the last commanded state.
 - c. Valves shall remain at the last commanded position.

3.04 TRAINING

- A. Upon completion of the work and at a time designated by the Owner, but before Warranty Commencement, provide a formal on-site training session for the Owner's operating personnel to include location, operation, and maintenance of all control equipment and systems per contract terms and conditions. This session will be video recorded and included in the closeout documents submitted to the Program Management Firm. Before proceeding with instruction, prepare a typed outline listing the subjects that will be covered. Submit the outline for review by the Architect/Engineer and the DISD representative.
- B. Documentation per Section 1.13 shall be provided to the Program Management Firm at or prior to training session. Deliver directly to Program Manager who will transmit to Dallas ISD Maintenance. Requirements of record documentation per 1.13 will still need to be issued as part of the closeout requirements

3.05 COORDINATION

- A. For construction project installations where electrical and mechanical contractors are responsible for their respective trade, the electrical contractor is to provide line voltage to required equipment and the mechanical contractor is to install any devices that are to be included in piping systems. It is the controls contractor responsibility to provide all devices with diagrams for location and coordinate with mechanical contractor prior to mechanical contractor starting installations. For installations where controls only, work is provided, all necessary work shall be performed by the controls contractor. Controls Contractor shall coordinate and provide all interface with smoke detectors and fire alarm.

3.06 OTHER REQUIREMENTS

- A. Provide wiremold where wiring must run exposed. Obtain advance approval from Architect and Owner before running exposed. Coordinate with Owner and Architect.
- B. For all wiring, provide numbering on all terminations (both ends).
- C. Label all panels, cans, enclosures, and correlate with air conditioning units served. Labeling shall relate to shop drawings and equipment served. Provide wiring diagram inside each enclosure.

- D. Provide Owner with compact disk with graphic diagrams and drawings. Include map of District with schools located and floor plan of each school with equipment located.
- E. This Contractor shall provide a Project Manager with a minimum of 3 years' experience with installation and set-up of the equipment of the Bidder/Manufacturer they represent.
- F. Locate outdoor air sensors shielded and on northern exposure.

3.07 INSTALLATION REQUIREMENTS

- A. Any panels associated with the control system shall be furnished and installed under this section of the work. Panel wiring shall be terminated by connecting to numbered terminals strips. Wire nut connections shall not be allowed. All wiring shall be color coded and shall be tagged for future identification.
- B. Controls contractor shall install JACE controller(s) in MDF/IDF room. Contractor shall provide and route all data lines and cabling from JACE as required for an operational networked system.
- C. Unless otherwise specified, all devices, panels, etc., furnished and/or installed by the Contractor shall be located where they can be calibrated and maintained from the floor without use of a ladder. [JS33]These items shall be identified by means of plates made of plastic suitably engraved, embossed or punched, plastic tape will not be acceptable. At completion of job, the Contractor shall submit record drawings of any changes made during construction. This submittal shall be a condition of final payment.
- D. Any conduit on roof shall be absolute minimum and shall have prior written approval.
- E. All conduit used indoor and outdoor shall be metal and shall be of type and fittings to minimize corrosion and moisture entry.

3.08 CABLE INSTALLATION AND ATTACHMENTS

- A. Control System wiring and equipment installation shall be in accordance with good engineering practices as established by the TIA/EIA and the NEC. Wiring shall meet all state and local electrical codes. All wiring shall test free from all grounds and shorts. All cable shall be supported from the building structure and bundled.
- B. The support system shall provide a protective pathway to eliminate stress that could damage the cabling. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling. Controls cables shall not be run loose on ceiling grid or ceiling tiles. Support shall be provided by mounting appropriate fasteners which may be loaded with multiple cables. Provided that the weight load is carried by the support rod or wire, the support assembly may attach to the ceiling grid for lateral stabilization. The required support wires for the ceiling grid or light fixtures shall not be utilized. Any fastener attached to the ceiling grid shall not interfere with inserting or removing ceiling tiles. All cabling and supports must be positioned at least 12 inches above the ceiling grid.
- C. Controls cables shall be run in bundles above accessible ceilings and supported from building structure. Cabling shall be loosely bundled with wire wraps randomly spaced at 30 to 48 inches on center, wire wraps shall not be tight enough to deform cabling and shall not be used to support the cabling.
- D. Attachments for cabling support shall be spaced at 48 to 60 inches on center. The cable bundle shall not be allowed to sag more than 12 inches mid-span between attachments. Attachments shall be sized as follows:

Bundles greater than 2" dia. or provide cable tray
- E. Do not mix different signal strength cables on the same J-Hook (i.e. fire alarm, 25 volt speaker cable). Multiple J-Hooks can be on the same attachment point up to the rated weight of the attachment device

- F. Controls cables shall be run in conduit stubs, where stubs are provided, from wall mounted devices to above accessible ceilings. Conduit shall be required only within walls and concealed spaces to provide access. Provide a plastic snap bushing or sleeve on the end of each conduit stub such as Thomas & Betts Catalog no. 443 - 3/4", 424 - 1", 425 - 1 1/4", 427 - 2" or equivalent.
- G. Conduit, duct or track shall be used for controls cable in exposed areas.
- H. All conduit, ducts, track and raceways shall be supported from the structure at industry standard intervals for the size specified, utilizing proper anchoring devices and techniques for each type of cable used.
- I. All penetrations through fire rated walls or floors shall feature a short length of metal conduit. The hole shall be neatly cut, not oversize or irregular. Seal the interior of the conduit sleeve around the cables and around the outside of the sleeve on each side of the penetration with fire- stop caulk or putty, such as Minnesota Mining & Mfg. Co. (3M) - CP 25WB+ caulk, MPS-2+ putty, or equivalent. Install according to the manufacturers' instructions.
- J. All cabling and equipment shall be located and installed as follows:
 - 1. All cable shall have a label on both ends utilizing self-laminating, flexible vinyl film and non-smear nylon marking pens. Utilize Tyton Corporation Part No. RO175 Rite-On labels and Part No. FTP1 nylon marking pens or equivalent.
 - 2. Each cable run shall include a three foot service loop with wire tie located in the ceiling above the control unit panel. This is to allow for future re-termination or repair.
 - 3. No terminations or splices shall be installed in or above ceilings. Cable shall be continuous from one device termination to the next.
 - 4. Mount all equipment firmly in place. Route cable in a professional, neat and orderly installation.
 - 5. All cabling shall be placed with regard to the environment, EMI/RFI (interference) and its effect on communication signal transmission.
 - 6. Do not route any controls cable within two feet of any light fixture, HVAC unit service access area, electric panel, or any device containing a motor or transformer.
 - 7. Low voltage controls cable will not be installed in the same conduit, duct or track with line voltage electrical cable.
 - 8. Maximum pulling tension should not exceed 25 lb/ft. or manufactures recommendation, whichever is less.
 - 9. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.
 - 10. Cable bends shall not exceed the manufacturers' suggested bend radius.
 - 11. XVIII. Provide for adequate ventilation in all equipment panels.
- K. Termination practices:
 - 1. Strip back only as much cable jacket as required to terminate.
 - 2. Preserve wire twists as closely as possible to point of termination (0.5" maximum) to keep signal impairment to a minimum.
 - 3. Avoid twisting cable during installation.

3.09 PROGRAMMING

- A. Prior to completion of the control installation, schedule time with Owner's designated representatives to evaluate and select programming options and requirements. Contractor shall provide engineer for such meetings and consultations on an as-needed basis. Preparation time for the conference shall be in addition to the "in conference" time, and shall be provided on an as-needed basis without additional cost to the Owner.
- B. The Contractor shall also provide additional coordination as needed with the Owner's representative and Engineer to formulate and determine functions, reports, graphics, and alarms most desirable and suitable for the school district and writing the software capability. Programming of these items shall be

provided. The Contractor shall program the system using coordinated Owner provided schedules for time of day and holidays.

- C. No hardware change shall be required for program changes.

3.10 COMMISSIONING

- A. The FMCS Contractor shall provide the following items as part of their scope of work to assist the Commissioning Authority (CxA).
1. Fill out and sign completed construction and startup checklists that will provided by the CxA for each type of HVAC system. Provide completed checklists to CxA.
 2. Provide personnel to assist CxA in the verification of a sample of the checklists. This will include accompanying the CxA for onsite observation and providing access to the necessary programming and graphics during the testing.
 3. Provide personnel to demonstrate that existing systems at the campus are correctly interfaced with the new system.
 4. Provide personnel to assist CxA in the resolution of deficiency items that are identified in the Issues Log as created by the CxA.
 5. Provide personnel to assist CxA in the verification of a sample of the checklists. This will include accompanying the CxA for onsite observation and providing access to the necessary programming and graphics during the testing.
 6. Provide personnel to demonstrate that existing systems at the campus are correctly interfaced with the new system.
 7. Provide personnel to assist CxA in the resolution of deficiency items that are identified in the Issues Log as created by the CxA.

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**SECTION 230925
VARIABLE FREQUENCY DRIVES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1 Specifications and Section 23 00 10, apply to this Section.

1.02 SECTION INCLUDES

- A. Variable Frequency Drive (VFD)
- B. Options, include bypass

1.03 SCOPE

- A. This section provides specification for AC variable frequency drives or herein identified as VFD's for use with NEMA B, NEMA D, NEMA A, NEMA E, Wound Rotor, Synchronous design AC motors.
- B. The VFD manufacturer shall furnish, test, adjust and certify all packages systems for satisfactory operation prior to shipment.
- C. Any exceptions / deviations to this specification shall be indicated in writing and submitted.

1.04 REFERENCES

- A. EN 61010-1 - Safety requirement for electrical equipment for measurement, control, and laboratory use. Part 1 - General Requirements
- B. EN 60204-1 - Safety of machinery-electrical equipment of machines. Part 1 - Specification for general requirements.
- C. EN 60950 - Safety of information technology equipment including electrical business equipment.
- D. IEC 664 - Insulation coordination for equipment within low- voltage systems.
- E. IEC 60068-2-6 - Environmental testing - Part 2 - Test Fc: vibration (sinusoidal).
- F. IEC 60068-2-27 - Environmental testing. Part 2: Tests. Test Ea and guidance: Shock
- G. IEC 801-4 - Electrical Fast Transient (Supplementary Wave). IEEE C62.41 - Recommended Practice on Surge Voltages in Low- Voltage AC Power Circuits.
- H. NEC - National Electrical Code
- I. NEMA ICS6 - Industrial control and systems enclosures. NEMA 250 - Enclosures for electrical equipment
- J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- K. NEMA FU1 - Low Voltage Cartridge Fuses.
- L. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
- M. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
- N. UL 508 - Industrial control equipment.
- O. UL 508C - Power conversion equipment.
- P. UL 508C - Testing standard
- Q. UL Type 1 or Type 12 - As listed in the contract documents

1.05 SUBMITTALS

- A. Provide submittal data on all items specified in this section in accordance with Specification Section 23 00 10, General Conditions, and Division 1.
- B. Product Data:
 - 1. Provide as outlined in the contract documents previously issued:
 - a. General description, voltage, horsepower, max current ratings, diagrams.
 - b. Ratings and weights.
- C. Shop Drawings:
 - 1. Provide as outlined in the contract documents previously issued:
 - a. Outline dimensions.
 - b. Mounting points.
 - c. Interconnecting wiring diagrams.
- D. Manufacturer's Installation Instructions:
 - 1. Provide with each variable frequency drive at time of shipment and submittal:
 - a. Installation methods
 - b. Connection points
- E. Submit product data for Variable Frequency Drive (VFD) with submittal package. Include manufacturer, dimensions, ratings, listings, elementary power and control wiring diagrams and data on features and components. Provide mounting points and connection points. Any exceptions to the specification shall be clearly noted in the submittal.

1.06 QUALITY ASSURANCE

- A. The VFD and options shall comply with the applicable requirements of the latest standards of ANSI, IEEE, and the National Electrical Code.
- B. The VFD and options shall be tested to ANSI/UL Standard 508 and listed by a nationally recognized testing agency such as UL or ETL. Device shall bear label.
- C. To ensure quality and minimize infantile failures at the jobsite, the VFD shall be "burned in" for 24-hours by the manufacturer.
- D. All VFD shall be UL listed for short circuit current rating of 100 kA and UL label shall be attached accordingly.
- E. All VFD system door mounted pilot devices shall be tested to verify successful operation. Documentation shall be provided upon the request of the engineer.
- F. All features shall be functionally tested at the factory for proper operation.

1.07 WARRANTY

- A. VFD shall be free from defects in materials and workmanship under normal use and service for a period of 3 year from substantial completion.

PART 2 PRODUCTS

2.01 GENERAL

- A. Manufacturers:
 - 1. ABB
 - 2. Danfoss
 - 3. Trane
- B. Furnish complete variable speed drives as specified herein. All standard and optional features requested shall be included within the VFD enclosure unless otherwise specified. Drives shall be for variable torque load, unless otherwise noted.

- C. The variable speed drives shall convert three-phase, 60 HZ utility power to adjustable voltage and frequency, three-phase, AC power for step less motor speed control from 10% to 100% of the motor's 60 Hz speed. Input voltage shall be as specified in the schedule.
- D. The VFD power input stage shall convert three-phase AC line power to a fixed DC bus voltage. This will be accomplished with a solid state three- phase full-wave diode rectifier with metal oxide varistor (MOV) three-phase protection. Displacement power factor shall not be less than 0.95 throughout the speed range. Input line inductors (3%) shall be included on the line side of the power input state for units that have saturating (non-linear) DC link reactors.
- E. The VFD output power shall vary frequency to the motor from 6 to 60 Hz with resultant motor speed varying at the motor nameplate rated speed, with output voltage variation from zero to motor rated voltage for optimum volts per hertz (V/Hz) ratio for fan and pump loads. Output current shall be rated 110% of motor full load amps (FLA) for 1 minute based upon VFD's variable torque FLA rating. The output must be a voltage source type generating a sine coded PWM waveform utilizing an asynchronous carrier frequency (output transistor switching frequency is to be independent of drive output frequency). This carrier frequency shall be adjustable to minimize harmonically induced noise or vibration.
- F. All VFD shall contain integral EMI filters to attenuate radio frequency interference conducted to the AC power line.
- G. VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD operation while reducing motor noise. VFDs with fixed carrier frequency are not acceptable.

2.02 FEATURES

- A. The VFD shall include the following features:
 - 1. The VFD shall be housed in a NEMA 1 enclosure for indoor applications.
 - 2. The VFD shall be housed in a NEMA 3R enclosure for outdoor applications.
 - 3. The following display/control parameters shall be located on the front of the enclosure:
 - a. Hand/Off/Auto selector to start and stop the motor. In the auto position, the drive shall start/stop from a remote contact closure. In the auto position, motor speed shall be determined by the follower signal. In the manual position, motor speed shall be determined by manual adjustment.
 - b. Power on indication that the VFD is being supplied by the power line.
 - c. Fault indication that the VFD has tripped on a fault condition.
 - d. Display shall indicate load parameters such as load percent, frequency or running load amps.
 - e. A set of form C, dry contacts to indicate when the VFD is in the run mode.
 - f. A set of form C, dry contacts to indicate when the VFD is in the fault mode.
 - g. Terminations for safety interlocks such as freeze and smoke shut-down.
 - h. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function shall provide up to 6 programmable restart attempts. The time delay before restart attempts shall be a minimum of 30 seconds. This function permits automatic restarting after the drive controller detects a fault, provided that the other operating functions are correct, a run command is present, and the fault has disappeared. This shall be a function that is field selectable.
 - i. The VFD shall include a door interlocked, padlockable, input power disconnect switch.
- B. The following bypass features shall be included:
 - 1. Manual bypass shall provide all the circuitry necessary to transfer the motor from the VFD to the power line, or from the line to the controller.

2. The AC Drive shall include mechanically and electrically interlocked isolation and bypass contactors complete with thermal overload relay, VFD/OFF/BYPASS switch and TEST/NORMAL selector switch.
 3. Motor overload protection shall be provided in both the controller mode and the bypass mode.
 4. The operator shall have full control of the bypass starter by operation of the VFD/OFF/BYPASS selector switch.
 5. In the automatic mode of operation the isolation and bypass contactors shall be sequenced by the 110 volt rated auto start contact provided by user.
 6. A test/normal selector switch shall provide test operation of the power converter while operating the motor in bypass.
 7. A pilot light shall indicate whether motor is operating in drive or bypass mode.
- C. Speed Reference Input:
1. Shall accept both a manual speed signal and a 0-10 VDC speed reference analog input signal from the Building Automation System (BAS). The input signal will generally be a temperature signal on single zone VAV applications or cooling tower control or a pressure signal on VAV applications.
- D. Feedback Signal:
1. Provide 0-5 VDC or 0-20 mA analog output signal to indicate actual operating speed of VFD. Output signal shall be fed into the BAS.
- E. The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communications protocols at no additional cost and without the need to install any additional hardware or software in the VFD: BacNet MS/TP, Lonwork Free Topology (FTP) and Modbus.

2.03 PROTECTIVE FEATURES

- A. The VFD shall include the following protective features:
1. Protection against input transient voltage spikes.
 2. Separate overload protection for each motor controlled.
 3. Protection against input power under voltage, over voltage, and phase loss.
 4. Protection against output current overload and over current.
 5. Protection against over temperature within the VFD enclosure.
 6. Protection against over voltage on the DC bus.
 7. DC bus discharge circuit for protection of service personnel.
 8. Insensitive to incoming power phase sequence.
 9. The number of restart attempts shall be adjustable from 0 to 20 and the time between attempts shall be adjustable between zero and 600 seconds. The original set-up shall be 4 restarts with 120 seconds between restarts.
 10. Four programmable critical frequency lockouts ranges to prevent the VFD from operating the load at a speed that causes vibration in the driven equipment.
 11. An automatic start delay may be selected from 0 to 120 seconds. During the start delay the VFD shall be programmed to provide either no voltage to the motor or apply DC braking current if desired.

2.04 ADJUSTMENTS

- A. The VFD shall include the following adjustments inside the enclosure:
1. Maximum speed, adjustable 50-100% base speed.
 2. Minimum speed, adjustable 0-50% base speed.
 3. Acceleration time, adjustable 3 to 1800 seconds.
 4. Deceleration time, adjustable 3 to 1800 seconds with override circuit to prevent nuisance trips if decel time is set too short.

5. Current limit, adjustable 0-100%.

2.05 SERVICE CONDITIONS

- A. The VFD shall be designed to operate within the following service conditions:
 1. XVIII. Ambient temperature, 14 to 113°F.
 2. 0 to 95% relative humidity, non-condensing.
 3. Elevation to 3,300 feet without derating.
 4. AC line voltage variation, -10% to +10% of nominal.
 5. No side clearance shall be required for cooling.
 6. XXIII. All VFD shall be plenum rated.

PART 3 EXECUTION

3.01 START UP SERVICE

- A. The manufacturer shall provide start up service by a factory trained service technician. The service technician shall verify correct installation, start up the drive, and check for proper operation.
- B. The VFD's shall be mounted and installed in accordance with all local, state, federal and NEC codes.
- C. Protection:
 1. Before and during the installation, the VFD shall be protected from site and environmental contaminants.
- D. Installation:
 1. Installation shall be in compliance with the manufacturer's instructions, drawings and recommendations.
- E. Start-up Assistance:
 1. On-site assistance shall be available from a factory certified technical representative who shall supervise the contractor's installation, testing and start-up of the VFD.
- F. Do not install VFD until building environment can be maintained in accordance with manufacturer's instructions.

3.02 TRAINING

- A. The manufacturer shall have regularly scheduled maintenance and training schools on the equipment supplied.
- B. Training course shall be quoted as a separate line item with submittal.

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**SECTION 232113
HYDRONIC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Chilled water piping, buried.
- D. Chilled water piping, above grade.
- E. Equipment drains and overflows.
- F. Pipe hangers and supports.
- G. Unions, flanges, mechanical couplings, and dielectric connections.
- H. Valves:
 - 1. Pressure independent temperature control valves and balancing valves.

1.02 RELATED REQUIREMENTS

- A. Section 083100 - Access Doors and Panels.
- B. Section 230553 - Identification for HVAC Piping and Equipment.
- C. Section 230719 - HVAC Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- C. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250; 2018.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.
- F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- G. ASME B31.9 - Building Services Piping; 2020.
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
- I. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2019a.
- J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.
- K. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- L. ASTM B32 - Standard Specification for Solder Metal; 2020.
- M. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.
- N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- O. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

- P. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
- Q. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2021.
- R. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2020.
- S. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- T. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
- U. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).
- V. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
- W. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- X. AWWA C606 - Grooved and Shouldered Joints; 2015.
- Y. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.04 SUBMITTALS

- A. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
- B. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.
- C. Shop Drawings: Indicate pipe fittings, particulars such as gages, sizes, and configuration prior to start of work for [all piping] systems. Provide drawings in 1/4" per foot scale or larger.

1.05 QUALITY ASSURANCE

- A. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 - 3. Grooved mechanical joints may be used in accessible locations only.

- a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
 - b. Grooved mechanical connections and joints comply with AWWA C606.
 - 1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
 - 2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
 - c. Use rigid joints unless otherwise indicated.
 4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- D. Valves: Provide valves where indicated:
1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
 2. For throttling, bypass, or manual flow control services, use ball or butterfly valves.
 3. For shut-off and to isolate parts of systems or vertical risers, use gate, ball, or butterfly valves.
 4. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

2.02 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 2. Threaded Joints: ASME B16.3, malleable iron fittings.
 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
 4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) NIBCO.
 - 2) Victaulic Company.
 - 3) Viega LLC.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn, using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 3. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) Grinnell Products, a Tyco Business.
 - 2) Viega LLC.
 - 3) NIBCO.

2.03 CHILLED WATER PIPING, BURIED

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.

2. Joints: Welded in accordance with AWS D1.1/D1.1M.
3. Casing: Closed glass cell insulation.

2.04 CHILLED WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 2. Threaded Joints: ASME B16.3, malleable iron fittings.
 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
 4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) NIBCO.
 - 2) Victualic Company.
 - 3) Viega LLC.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:
 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 3. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
 - a. Manufacturers:
 - 1) Grinnell Products, a Tyco Business.
 - 2) Viega LLC.
 - 3) NIBCO.

2.05 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
- B. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
 1. Fittings: ASTM D2466 or D2467, PVC.
 2. Joints: Solvent welded in accordance with ASTM D2855.

2.06 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58. Refer to Section 230529 Hangers and Supports for HVAC Piping and Equipment.
 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
 5. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
 8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 9. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

- B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.07 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe of 2 Inches and Less:
 - 1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
 - 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches and Greater:
 - 1. Ferrous Piping: 150 psig forged steel, slip-on.
 - 2. Copper Piping: Bronze.
 - 3. Gaskets: 1/16 inch thick, preformed neoprene.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 - 1. Dimensions and Testing: In accordance with AWWA C606.
 - 2. Mechanical Couplings: Comply with ASTM F1476.
 - 3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 - 4. When pipe is field grooved, provide coupling manufacturer's grooving tools.
- D. Dielectric Connections:
 - 1. Waterways:
 - a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - b. Dry insulation barrier able to withstand 600-volt breakdown test.
 - c. Construct of galvanized steel with threaded end connections to match connecting piping.
 - d. Suitable for the required operating pressures and temperatures.
 - 2. Flanges:
 - a. Dielectric flanges with same pressure ratings as standard flanges.
 - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
 - c. Dry insulation barrier able to withstand 600-volt breakdown test.
 - d. Construct of galvanized steel with threaded end connections to match connecting piping.
 - e. Suitable for the required operating pressures and temperatures.

2.08 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES AND BALANCING VALVES

- A. Manufacturers:
 - 1. Armstrong Pumps, Inc.
 - 2. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - 3. Flow Design Inc.
 - 4. Gerand Engineering Co.
 - 5. Griswold Controls.
 - 6. Taco.
- B. Control Valves: Factory-fabricated pressure independent with internal differential pressure regulator (DPRV), which automatically adjusts to normal changes in system pressure and provides 100 percent control valve authority at all positions of the valve.
 - 1. PICV to accurately control the flow from 0 to 100 percent full rated flow with an operating pressure differential range of 3 to 60 psig.
 - 2. Provide control valve to incorporate control, balancing, and flow limiting. Hydronic system pressure independent control valve bodies to comply with ASME B16.34 or ASME B16.15

- pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure and have the following characteristics:
- a. 2 NPS and Smaller: Class 150 bronze body with union connections, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, and screwed ends with backseating capacity repackable under pressure.
 - b. 2-1/2 NPS and Larger: Class 125 iron or ductile iron body, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, flanged ends with backseating capacity repackable under pressure.
 - c. Pressure Control Seat: Brass construction with vulcanized EPDM.
 - d. Sizing: Line-size.
 - e. Close-Off (Differential) Pressure Rating: Combination of actuator, DPRV action, and trim to provide a minimum close-off pressure rating of 150 percent of total system (pump) head.
- C. Electronic Actuators: Direct-mounted, self-calibrating type designed for minimum 60,000 full-stroke cycles at rated force.
- D. Provide actuator with visible position indication. Fail positions on power failure to include in-place, open or closed as indicated in the controls specifications.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interference with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls, and floors.
- G. Slope piping and arrange to drain at low points.
- H. Grooved Joints:
 - 1. Install in accordance with the manufacturer's latest published installation instructions.
 - 2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
- I. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- J. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.

4. Place hangers within 12 inches of each horizontal elbow.
 5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 8. Provide copper plated hangers and supports for copper piping.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 230719.
- L. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 083100 .
- M. Use eccentric reducers to maintain top of pipe level.
- N. Install valves with stems upright or horizontal, not inverted.

3.03 SCHEDULES

- A. Piping Applications:
1. Hot-water heating piping, above ground, NPS 2 and smaller, shall be one of the following:
 - a. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or mechanical pressure-seal joints.
 - b. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; threaded or pressure-seal joints.
 2. Hot-water heating piping, above ground, NPS 2-1/2 and larger, shall be one of the following:
 - a. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints; pressure seal joints are acceptable on piping NPS 4 and smaller.
 - b. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints; pressure seal joints are acceptable on piping NPS 4 and smaller.
 - c. Schedule 40 steel pipe, grooved, mechanical joint coupling and fitting; and grooved mechanical joints.
 3. Chilled-water piping, above ground, NPS 2 and smaller, shall be one of the following:
 - a. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or mechanical pressure-seal joints.
 - b. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; threaded or pressure-seal joints.
 4. Chilled-water piping, above ground, NPS 2-1/2 and larger, shall be one of the following:
 - a. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints; pressure seal joints are acceptable on piping NPS 4 and smaller.
 - b. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints; pressure seal joints are acceptable on piping NPS 4 and smaller.
 - c. Schedule 40 steel pipe, grooved, mechanical joint coupling and fitting; and grooved mechanical joints.
 5. Condensate drain piping shall be one of the following:
 - a. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or mechanical pressure-seal joints.
 - b. Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.
- B. Hanger Spacing for Copper Tubing.
1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.

2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 4. 2-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 5. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 6. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
 7. 6 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 8. 8 Inches: Maximum span, 16 feet; minimum rod size, 5/8 inch.
 9. 10 Inches: Maximum span, 18 feet; minimum rod size, 3/4 inch.
 10. 12 inches: Maximum span, 19 feet; minimum rod size, 7/8 inch.
- C. Hanger Spacing for Steel Piping.
1. 1/2 Inch, 3/4 Inch, and 1 Inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 2. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 3. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 4. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 6. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 7. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 8. 6 Inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 9. 8 Inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
 10. 10 Inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
 11. 12 Inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.
- D. Hanger Spacing for Plastic Piping.
1. 1/2 Inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
 2. 3/4 Inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
 3. 1 Inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
 4. 1-1/4 Inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.
 5. 1-1/2 Inches: Maximum span, 63 inches; minimum rod size, 3/8 inch.
 6. 2 Inches: Maximum span, 69 inches; minimum rod size, 3/8 inch.

END OF SECTION

**SECTION 232114
HYDRONIC SPECIALTIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Suction diffusers.
- F. Pump connectors.
- G. Combination pump discharge valves.

1.02 REFERENCE STANDARDS

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.

1.03 SUBMITTALS

- A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.01 EXPANSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc.
 - 2. ITT Bell & Gossett.
 - 3. Taco, Inc.
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible EPDM diaphragm or bladder seal factory precharged to 12 psi, and steel support stand.
- C. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.02 AIR VENTS

- A. Manufacturers:
 - 1. Armstrong International, Inc.
 - 2. ITT Bell & Gossett.
 - 3. Taco, Inc.
 - 4. Amtrol, Inc.

- B. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- C. Float Air Vent:
 - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- D. Maximum Fluid Pressure: 150 psi.
- E. Maximum Fluid Temperature: 250 degrees F.

2.03 AIR SEPARATORS

- A. In-line Air Separators:
 - 1. Manufacturers:
 - a. Armstrong International, Inc.
 - b. ITT Bell & Gossett.
 - c. Taco, Inc.
 - 2. Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with ASME BPVC-VIII-1; for 125 psi operating pressure.
 - 3. Maximum Allowable Service Temperature: 450 degrees F.

2.04 STRAINERS

- A. Size 2 inch and Under:
 - 1. Provide threaded, grooved, or sweat brass or iron body for up to 175 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated screen.
- B. Size 2-1/2 inch to 4 inch:
 - 1. Provide flanged or grooved iron body for 175 psi working pressure, Y pattern with 1/16 inch stainless steel perforated screen.
- C. Size 5 inch and Larger:
 - 1. Provide flanged or grooved iron body for 175 psi working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.05 SUCTION DIFFUSERS

- A. Manufacturers:
 - 1. Anvil International, Inc.
 - 2. Grinnell Products, a Tyco Business.
 - 3. Victaulic Company of America.
- B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh startup screen, and permanent magnet located in flow stream and removable for cleaning.
- C. Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.06 PUMP CONNECTORS

- A. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
 - 1. Maximum Allowable Working Pressure: 150 psig at 250 degrees F.
 - 2. Accommodate the Following:
 - a. Axial Deflection in Compression and Expansion: 3/4 inch.
 - b. Lateral Movement: 3/4 inch.
 - c. Angular Rotation: 15 degrees.
 - d. Force developed by 1.5 times specified maximum allowable operating pressure.

3. End Connections: Same as specified for pipe jointing.
4. Provide necessary accessories including, but not limited to, swivel joints.

2.07 COMBINATION PUMP DISCHARGE VALVES

- A. Manufacturers:
 1. Crane Co..
 2. Taco, Inc.
 3. Victaulic Company of America.
- B. Quarter-Turn Plug Type: Flanged cast-iron body with bolt-on bonnet, position indicator, stainless steel stem, backflow preventer, memory stop, metering connectors, bubble-tight shutoff, and wrench-adjustable plug flow regulator.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Provide manual air vents at system high points and as indicated.
- C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- E. Provide valved drain and hose connection on strainer blowdown connection.
- F. Provide pump suction fitting on suction side of base-mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.
- G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.
- H. Support pump fittings with floor-mounted pipe and flange supports.
- I. Pipe relief valve outlet to nearest floor drain.
- J. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

END OF SECTION

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**SECTION 232123
HYDRONIC PUMPS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following categories of hydronic pumps for hydronic systems:
 - 1. End-suction pumps.
- B. Related Sections include the following:
 - 1. Division 23 Section "Motors" for general motor requirements.
 - 2. Division 23 for inertia pads, isolation pads, spring supports, and spring hangers.

1.03 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities; shipping, installed, and operating weights; 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: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For pumps to include in maintenance manuals specified in Division 1.

1.04 QUALITY ASSURANCE

- A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor- Operated Water Pumps," for construction requirements.
- B. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Subject to these specification requirements, other manufacturers' pumps with equal performance characteristics may be considered. Any additional cost required due to the contractors use of an alternate manufacturer shall be the contractor's responsibility and there shall be no additional cost to the owner.
- 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.

1.05 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.

1.06 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

1.07 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 for each pump.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. End-Suction Pumps:
 - a. Armstrong
 - b. Bell & Gossett
 - c. PGrundfos/PACO
 - d. Taco

2.02 GENERAL PUMP REQUIREMENTS

- A. Pump Units: Factory assembled and tested.
- B. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be non-overloading over full range of pump performance curve.
 - 1. Minimum efficiency as indicated according to IEEE 112, Test Method B. Include motors with higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B.

2.03 FLEXIBLE-COUPLED, END-SUCTION PUMPS

- A. Description: Base-mounted, centrifugal, flexible-coupled, end-suction, single- stage, bronze- fitted, back-pull-out, radially split case design; rated for 175- psig minimum working pressure and a continuous water temperature of 225 deg F.
 - 1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.
 - 2. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
 - 3. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
 - 4. XLIII. Wear Rings: Replaceable, bronze casing ring.
 - 5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 6. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
 - 7. Seals: Stuffing box, with at least four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
 - 8. XLVII. Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
 - 9. XLVIII. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
 - 10. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment for motor sizes of 100 hp and smaller; with flange and sleeve section that can be disassembled and removed without removing pump or motor, for sizes larger than 100 hp.
 - 11. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
 - 12. Coupling Guard: Steel, removable, and attached to mounting frame.

13. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.
 - a. Option: Cast-iron frames are acceptable.
14. Motor: Secured to mounting frame, with adjustable alignment.

2.04 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser: Angle or straight pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.
- B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump- discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.
 1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
 2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PUMP INSTALLATION

- A. Install pumps according to manufacturer's written instructions.
 1. Install pumps according to HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."
- B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- C. Support pumps and piping separately so piping is not supported by pumps.
- D. Suspend in-line pumps using continuous-thread hanger rod and vibration- isolation hangers. Install seismic bracing as required by authorities having jurisdiction.
- E. Set base-mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
 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.
- F. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.03 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after 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."
- 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.

3.04 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 the 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 check valve and throttling valve on discharge side of in-line circulators.
- F. Install nonslam check valve and globe valve on discharge side of vertical in-line pumps.
- G. Install suction diffuser and shutoff valve on suction side of vertical in-line pumps.
- H. Install triple-duty valve on discharge side of vertical in-line pumps.
- I. Install suction diffuser and shutoff valve on suction side of base-mounted pumps.
- J. Install triple-duty valve on discharge side of base-mounted pumps.
- K. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- L. Install pressure gages on pump suction and discharge. Install at integral pressure-gage tapplings where provided.
- M. Install temperature and pressure-gage connector plugs in suction and discharge piping around each pump.
- N. Install check valve and gate or ball valve on each condensate pump unit discharge.
- O. Install electrical connections for power, controls, and devices.
- P. Electrical power and control wiring and connections are specified in Division 16 Sections.
- Q. Ground equipment.
 - 1. 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.

3.05 COMMISSIONING

- A. Verify that pumps are installed and connected according to the Contract Documents.
- B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.
- C. Perform the following preventive maintenance operations and checks before starting:
 - 1. Lubricate bearings.
 - 2. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
 - 3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
 - 4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
 - 5. Check suction piping connections for tightness to avoid drawing air into pumps.
 - 6. Clean strainers.
 - 7. Verify that pump controls are correct for required application.
- D. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:
 - 1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.

2. Open cooling water-supply valves in cooling water supply to bearings, where applicable.
 3. Open cooling water-supply valves if stuffing boxes are water cooled.
 4. Open sealing liquid-supply valves if pumps are so fitted.
 5. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
 6. Open circulating line valves if pumps should not be operated against dead shutoff.
 7. Start motors.
 8. Open discharge valves slowly.
 9. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.
 10. Check general mechanical operation of pumps and motors.
 11. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.
- E. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.
- F. Refer to Division 23 for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
 2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 3. Review data in maintenance manuals. Refer to Division 1.
 4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

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**SECTION 232500
HVAC WATER TREATMENT**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes water-treatment systems for the following:
 - 1. Heating, hot-water piping (closed-loop system).
 - 2. Chilled-water piping (closed-loop system).
- B. Dallas Independent School District (DISD) will contract directly with Garratt- Callahan Company for chemicals
- C. All chemicals required for cleaning and treating of systems prior to Owner acceptance shall be provided as a part of this Section

1.03 CHEMICAL FEED SYSTEM DESCRIPTION

- A. Closed-Loop System: One bypass feeder on each system with isolating and drain valves downstream from circulating pumps, unless otherwise indicated.
 - 1. A. Introduce chemical treatment through bypass feeder when required or indicated by test.

1.04 SUBMITTALS

- A. Product Data: Include rated capacities; water-pressure drops; shipping, installed, and operating weights; and furnished products listed below if required in the configuration:

1.05 PERFORMANCE REQUIREMENTS

- A. Control build-up of scale and biological growth for maximum efficiency of installed equipment without posing a hazard to operating personnel or the environment.
- B. Base chemical treatment performance requirements on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.
 - 1. Closed System: Maintain system essentially free of scale, corrosion, and fouling to sustain the following water characteristics:
 - a. I. pH: 9-11
 - b. Iron: 0.5 ppm
 - c. Conductivity: = 4000 µmhos
 - d. Nitrite: 600-1500 ppm depending on chill or hot water system

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.07 MAINTENANCE

- A. Chemicals and service program for maintaining conditions in the circulating water for inhibiting corrosion, scale, and organic growths in the [cooling, chilled-water piping] [heating, hot-water piping] [condenser water piping] and equipment is provided under an existing Dallas Independent School District (DISD) water treatment contract for water treatment services. The contractor is responsible for providing water treatment chemicals and services prior to acceptance by the owner. DISD water treatment contractor shall provide all chemicals and water treatment services after owner acceptance.

PART 2 PRODUCTS

2.01 MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE PRODUCTS BY ONE OF THE FOLLOWING:

- A. Water-Treatment Products:
 - 1. Garratt-Callahan Company

2.02 CHEMICAL TREATMENT TEST EQUIPMENT

- A. Corrosion Test Coupon Assembly: Constructed of corrosion material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test coupon assembly.
 - 1. Two station rack for closed-loop systems.
 - 2. Three-station rack for open condenser water systems.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install treatment equipment level and plumb.

3.02 START UP

- A. Contractor shall be responsible to provide all equipment start up, cleaning, and water treatment services to properly prepare equipment and components for operation in accordance with manufacturer's recommendations. Upon completion of these start up procedures, the equipment and components shall be drained and inspected by the owner
 - 1. If acceptable to the owner, the contractor shall be responsible to provide all labor and materials necessary to refill and restart the systems. The contractor shall coordinate this process with the DISD water treatment contractor to assure all systems are filled and treated.
 - 2. At the completion of the process, subject to satisfaction of the owner, the owner should take beneficial acceptance of that portion of the system. All other elements of the systems shall remain the responsibility of the contractor.

3.03 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 equipment to allow service and maintenance.
- C. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
- D. Ground equipment.
- E. 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.

3.04 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to perform startup service.
- B. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
- C. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
- D. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.

3.05 TESTING

- A. Test chemical feed piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
 - 2. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
 - 5. Repair leaks and defects with new materials and retest piping until satisfactory results are obtained.
 - 6. XVIII. Prepare test reports, including required corrective action.

3.06 ADJUSTING

- A. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare certified test report for each required water performance characteristic. Where applicable, comply with ASTM D 3370 and the following standards:
 - 1. Silica: ASTM D 859.
 - 2. Acidity and Alkalinity: ASTM D 1067.
 - 3. Iron: ASTM D 1068.
 - 4. Water Hardness: ASTM D 1126.
- B. Occupancy Adjustments: Within 12 months of Substantial Completion, perform monthly separate water analyses to prove that automatic chemical feed systems are maintaining water quality within performance requirements specified in this Section. Perform analyses at least 21 days apart. Submit written reports of water analysis.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water- treatment systems and equipment.
- B. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
- C. Review manufacturer's safety data sheets for handling of chemicals.
- D. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Contract Closeout."
- E. Schedule at least two hours training with Owner.

END OF SECTION

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**SECTION 233100
HVAC DUCTS AND CASINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Nonmetal ductwork.
- C. Duct cleaning.

1.02 RELATED REQUIREMENTS

- A. Section 230593 - Testing, Adjusting, and Balancing for HVAC.
- B. Section 233300 - Air Duct Accessories.

1.03 REFERENCE STANDARDS

- A. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2025a.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2024.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2021.
- F. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
- G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- H. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

1.04 SUBMITTALS

- A. Product Data: Provide data for duct materials.
- B. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all duct systems. Provide drawings in 1/4" per foot scale or larger.
- C. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

- A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A, NFPA 90B, and NFPA 96 standards.
- B. Ducts: Galvanized steel, unless otherwise indicated.
- C. Low Pressure Supply (Heating Systems): 2 inch w.g. pressure class, galvanized steel.

- D. Low Pressure Supply (System with Cooling Coils): 2 inch w.g. pressure class, galvanized steel.
- E. Medium and High Pressure Supply: 4 inch w.g. pressure class, galvanized steel.
- F. Return and Relief: 2 inch w.g. pressure class, galvanized steel.
- G. General Exhaust: 2 inch w.g. pressure class, galvanized steel.
- H. Dishwasher Exhaust: 2 inch w.g. pressure class, stainless steel.
 - 1. Construct of 18 gauge, 0.0500 inch stainless steel using continuous external welded joints in rectangular sections.
- I. Grease Exhaust: 2 inch wg pressure class, stainless steel.
 - 1. Construct of 18 gauge, 0.0500 inch stainless steel.
 - 2. Construction:
 - a. Liquidtight with continuous external weld for all seams and joints.
 - b. Where ducts are not self draining back to equipment, provide low point drain pocket with copper drain pipe to sanitary sewer.
 - 3. Access Doors:
 - a. Provide for duct cleaning inside horizontal duct at drain pockets, every 20 feet and at each change of direction.
 - b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F for grease tight construction.
- J. Outside Air Intake: 2 inch w.g. pressure class, galvanized steel.
- K. Transfer Air and Sound Boots: 2 inch w.g. pressure class, galvanized steel.

2.02 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Un-Galvanized Steel for Ducts: ASTM A1008/A1008M Designation CS (commercial steel), cold-rolled.
- C. Stainless Steel for Ducts: ASTM A666, Type 316.
- D. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 75 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- E. Foil Mastic Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- F. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- G. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

2.03 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

- B. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- F. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

- A. Flat Oval Ducts: Machine made from round spiral lockseam duct.
 - 1. Manufacture in accordance with SMACNA (DCS).
 - 2. Fittings: Manufacture at least two gauges heavier metal than duct.
 - 3. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
 - 4. Manufacturers:
 - a. Ductmate Industries, Inc..
 - b. Linx Industries (formerly Lindab)..
 - c. SEMCO LLC..
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Spiral Ducts: Round spiral lockseam duct with galvanized steel outer wall.
 - 1. Manufacture in accordance with SMACNA (DCS).
- C. Round Ducts: Round lockseam duct with galvanized steel outer wall.
 - 1. Manufacture in accordance with SMACNA (DCS).
- D. Acoustic Flexible Ducts: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 - 1. Insulation: Fiberglass insulation with metallic vapor barrier.
 - 2. Inner Core: Spun-bonded, non-woven inner core.
 - 3. Pressure Rating: 6 inches wg positive and 5.0 inches wg negative.
 - 4. Maximum Velocity: 4000 fpm.
 - 5. Temperature Range: Minus 20 degrees F to 250 degrees F.
 - 6. Manufacturers:
 - a. Flexmaster USA, a brand of Masterduct, Inc
 - b. JP Lamborn Co
 - c. Quietflex Manufacturing Company
 - d. Thermaflex.
- E. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

- C. Flexible Ducts: Connect to metal ducts with adhesive plus sheet metal screws.
- D. Kitchen Hood Exhaust: Provide residue traps at base of vertical risers with provisions for clean out.
- E. Duct sizes indicated are inside clear dimensions.
- F. Provide openings in ductwork where required to accommodate thermometers and controllers.
Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- H. Use double nuts and lock washers on threaded rod supports.
- I. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- J. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

3.02 CLEANING

- A. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION

**SECTION 233300
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Turning vanes.
- B. Backdraft dampers - metal.
- C. Combination fire and smoke dampers.
- D. Duct access doors.
- E. Fire dampers.
- F. Flexible duct connectors.
- G. Volume control dampers.
- H. Section 233100 - HVAC Ducts and Casings.

1.02 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- B. NFPA 92 - Standard for Smoke Control Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- F. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- G. UL 555C - Standard for Safety Ceiling Dampers; Current Edition, Including All Revisions.
- H. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: For each type of product.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Fusible Links: One of each type and size.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 TURNING VANES

- A. Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Elgen Manufacturing, Inc.
 - 4. METALAIR, Inc.
 - 5. SEMCO LLC.
 - 6. Ward Industries, a brand of Hart and Cooley, Inc; _____.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.02 BACKDRAFT DAMPERS - METAL

- A. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.03 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 1. Louvers & Dampers, Inc, a brand of Mestek, Inc.
 2. Greenheck Fan Corporation.
 3. Nailor Industries, Inc.
 4. Pottorff.
 5. Ruskin Company, a brand of Johnson Controls.
- B. Dynamic; fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.
- E. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on exterior of duct and link to damper operating shaft.
- F. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.
- G. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.04 DUCT ACCESS DOORS

- A. Manufacturers:
 1. American Warming and Ventilating; a Mestek Group Company.
 2. Cesco Products; a division of MESTEK, Inc.
 3. Ductmate Industries, Inc.
 4. Elgen Manufacturing, Inc.
 5. Flexmaster U.S.A., Inc.
 6. Greenheck Fan Corporation.
 7. McGill AirFlow, LLC.
 8. Nailor Industries, Inc.
 9. Pottorff.
 10. Ruskin Company, a brand of Johnson Controls.

- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
 - 1. Less Than 12 inches Square: Secure with sash locks.
 - 2. Up to 18 inches Square: Provide two hinges and two sash locks.
 - 3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.
- D. Access doors with sheet metal screw fasteners are not acceptable.

2.05 FIRE DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc, a brand of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries, Inc.
 - 4. Pottorff.
 - 5. Ruskin Company, a brand of Johnson Controls.
- B. Dynamic; fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Ceiling (Radiation) Dampers: Galvanized steel, 22 gauge, 0.0299 inch frame and 16 gauge, 0.0598 inch flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
 - 1. Boot Fitting: Factory-provided el type (90 degree). Include field-provided collar.
 - 2. Rated for three hour service in compliance with UL 555C.
- D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.
- E. Fusible Links: UL 33, separate at 165 degrees F.

2.06 FLEXIBLE DUCT CONNECTORS

- A. Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Elgen Manufacturing, Inc.
 - 4. Ventfabrics, Inc.
 - 5. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 - a. Net Fabric Width: Approximately 2 inches wide.
 - 2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.
- D. Maximum Installed Length: 14 inch.

2.07 MANUAL VOLUME DAMPERS

- A. Manufacturers, Standard Leakage Rating, Steel:
 - 1. Louvers & Dampers, Inc, a brand of Mestek, Inc.
 - 2. Flexmaster U.S.A., Inc.
 - 3. McGill AirFlow LLC.

4. Nailor Industries, Inc.
 5. Pottorff.
 6. Ruskin Company, a brand of Johnson Controls.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Splitter Dampers:
- D. Single Blade Dampers:
1. Fabricate for duct sizes up to 6 by 30 inch.
 2. Blade: 24 gauge, 0.0239 inch, minimum.
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
1. Blade: 18 gauge, 0.0478 inch, minimum.
- F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
- G. Quadrants:
1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 3. Where rod lengths exceed 30 inches provide regulator at both ends.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide fire dampers and combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- E. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- F. Demonstrate re-setting of fire dampers to Owner's representative.
- G. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- H. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- I. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- J. Use turning vanes only where indicated.

- K. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

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SECTION 233423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof exhausters.
- B. Ceiling exhaust fans.
- C. Inline centrifugal fans and blowers.
- D. Kitchen hood upblast roof exhausters.

1.02 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2016.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.
- G. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
- H. UL 705 - Power Ventilators; Current Edition, Including All Revisions.
- I. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Fan Belts: One set for each individual fan.

1.04 FIELD CONDITIONS

- A. Permanent ventilators may not be used for ventilation during construction.

PART 2 PRODUCTS

2.01 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D. Fabrication: Comply with AMCA 99.
- E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

- G. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.02 ROOF VENTILATORS

- A. Manufacturers:
1. Greenheck Fan Corporation
 2. Loren Cook Company
 3. Twin City Fan & Blower
- B. Fan Unit: direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- C. Roof Curb: 20 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
- D. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.
- E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.
- F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- G. Performance Ratings: As indicated on drawings.

2.03 CEILING EXHAUST FANS

- A. Manufacturers:
1. Greenheck Fan Corporation
 2. Loren Cook Company
 3. Twin City Fan & Blower
- B. Centrifugal Fan Unit: direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- C. Grille: Aluminum with baked white enamel finish.
- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- E. Performance Ratings: As indicated on drawings.

2.04 INLINE CENTRIFUGAL FANS AND BLOWERS

- A. Manufacturers:
1. Greenheck Fan Corporation.
 2. Loren Cook Company.
 3. Twin City Fan & Blower.
- B. Centrifugal Fan Unit: direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- C. Forward Curved Blower:
1. Direct-driven, resiliently-mounted induction motor, heavy duty ball bearings, galvanized steel housing for indoor or outdoor service lined with acoustic insulation, and removable service panels.
 2. Operation: As indicated on drawings.
 3. Accessories: Provide backdraft damper and intake hood with bird screen.
- D. Disconnect Switch: Cord and plug in housing for thermal overload protected motor.

- E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- F. Performance Ratings: As indicated on drawings.

2.05 KITCHEN HOOD UPBLAST ROOF EXHAUSTERS

- A. Shafts and Bearings:
 - 1. Fan Shaft:
 - a. Ground and polished steel with anti-corrosive coating.
 - b. First critical speed at least 25 percent over maximum cataloged operating speed.
 - 2. Bearings:
 - a. Permanently sealed or pillow block type.
 - b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
 - c. 100 percent factory tested.
- B. Drive Assembly:
 - 1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
 - 2. Belts: Static free and oil resistant.
 - 3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
 - 4. Motor pulley adjustable for final system balancing.
 - 5. Readily accessible for maintenance.
- C. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Hung Cabinet Fans:
 - 1. Install flexible connections specified in Section 233300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof and wall exhausters.

END OF SECTION

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**SECTION 233600
AIR TERMINAL UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single-duct terminal units.
 - 1. Variable-volume units.

1.02 RELATED REQUIREMENTS

- A. Section 230993 - Sequence of Operations for HVAC Controls.
- B. Section 233100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addendum (2011).
- B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017.
- C. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units; 2016.
- D. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- G. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.04 SUBMITTALS

- A. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- B. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum eight years of documented experience.

PART 2 PRODUCTS

2.01 SINGLE-DUCT, VARIABLE-VOLUME UNITS

- A. Manufacturers:
 - 1. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp.
 - 2. Enviromental Technologies, Inc.
 - 3. Price Industries, Inc.
 - 4. Titus.
 - 5. Trane, a brand of Ingersoll Rand.
- B. General:
 - 1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
 - 2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

- C. Unit Casing:
 - 1. Minimum 22 gauge, 0.0299 inch galvanized steel.
 - 2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
 - 3. Unit Discharge: Rectangular, with slip-and-drive connections.
 - 4. Acceptable Liners:
 - a. 3/4 inch thick, coated, fibrous-glass complying with ASTM C1071.
 - 1) Secure with adhesive.
 - 2) Coat edges exposed to airstream with NFPA 90A approved sealant.
 - 3) Cover liner with non-porous foil.
 - b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
- D. Damper Assembly:
 - 1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
 - 2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
 - 3. Incorporate low leak damper blades for tight airflow shutoff.
 - a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 in-wc inlet static pressure, tested in accordance with ASHRAE Std 130.
- E. Hot Water Heating Coil:
 - 1. Coil Casing: Minimum 22 gauge, 0.0299 inch galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
 - 2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
 - a. Two rows with ten fins-per-inch heating capacity density.
 - 3. Coil leak tested to minimum.
 - 4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.
- F. Electrical Requirements:
 - 1. Single-point power connection.
 - 2. Equipment wiring to comply with requirements of NFPA 70.
- G. Controls:
 - 1. DDC (Direct-Digital Controls):
 - a. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
 - b. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFMs.
 - 1) Occupied and unoccupied operating mode.
 - 2) Remote reset of temperature or CFM set points.
 - 3) Proportional, plus integral control of room temperature.
 - 4) Monitoring and adjusting with portable terminal.
 - c. Room Sensor:
 - 1) Compatible with temperature controls specified.
 - 2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
 - 2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
 - a. Signal accuracy: Plus/minus five percent throughout terminal operating range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are suitable for installation.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure in accordance with SMACNA (SRM).
- E. Do not support from ductwork.
- F. Connect to ductwork in accordance with Section 233100.
- G. Verify that electric power is available and of the correct characteristics.

3.03 FIELD QUALITY CONTROL

- A. Provide manufacturer's field representative to inspect field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
 - 1. Leak Test:
 - a. After installation, fill water coils and test for leaks.
 - b. Repair leaks and retest until no leaks exist.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Test and adjust controls and safeties.
 - c. Replace damaged and malfunctioning controls and other equipment.
 - d. Remove and replace malfunctioning units and retest as specified above.

3.04 CLEANING

- A. Vacuum clean coils and inside of units.
- B. Install new filters.

END OF SECTION

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**SECTION 235216
CONDENSING BOILERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured units.
- B. Boiler construction.
- C. Boiler trim.
- D. Fuel burning system.
- E. Factory installed controls.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 232114 - Hydronic Specialties.
- C. Section 232123 - Hydronic Pumps.
- D. Section 232500 - HVAC Water Treatment.

1.03 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2025, with Errata.
- D. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.
- E. NFPA 54 - National Fuel Gas Code; 2021.
- F. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990, with Amendment (2018).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.
- C. Manufacturer's Installation Instructions: Indicate assembly, support details, connection requirements, and include start up instructions.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide a ten year warranty to include coverage for heat exchanger.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Natural Gas for Indoor Applications:
 - 1. LAARS Heating Systems Company
 - 2. Lochinvar LLC
 - 3. Patterson-Kelly
 - 4. Aerco

2.02 MANUFACTURED UNITS

- A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.
- B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.03 BOILER CONSTRUCTION

- A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
- B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.
- C. Required Directory Listings:
 - 1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
 - 2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.
- D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables. Provide stainless-steel heat exchanger.
- E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
- F. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.
- G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, or weather-proofed finish.

2.04 BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Flow switch.
- C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
- D. Temperature and pressure gauge.
- E. Pressure Switches:

1. High gas pressure.
 2. Low gas pressure.
 3. Air pressure.
- F. Manual reset high limit.
- G. Boiler Pump (where required by boiler design):
1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
 2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.
 3. Pump time delay.
- H. Acid neutralization kit

2.05 FUEL BURNING SYSTEM

- A. Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn natural gas, and maintain fuel-air ratios automatically.
1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
 2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
 3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
 4. Combustion Air Filter: Protects fuel burning system from debris.
- B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.
- C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.
- D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.06 FACTORY INSTALLED CONTROLS

- A. Option for internal or external (0-10) VDC control.
- B. Temperature Controls:
1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.
 2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
 3. Low-fire start time delay relay.
- C. Electronic PI setpoint/modulation control system.
- D. Microprocessor-based, fuel/air mixing controls.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.
- C. Install boiler on concrete housekeeping base, sized minimum of 4 inches larger than boiler base in accordance with Section 033000.
- D. Coordinate provisions for water treatment in accordance with Section 232500.
- E. Pipe relief valves to nearest floor drain.

- F. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.
- G. Install primary boiler pump in accordance with Section 232123.
- H. Provide piping connection and accessories in accordance with Section 232114.

3.02 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.

END OF SECTION

SECTION 236423
SCROLL WATER CHILLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air-cooled scroll water chillers.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete housekeeping pads.
- B. Section 230593 - Testing, Adjusting, and Balancing for HVAC.
- C. Section 230800 - Commissioning of HVAC.
- D. Section 230993 - Sequence of Operations for HVAC Controls.
- E. Section 232113 - Hydronic Piping.
- F. Section 232114 - Hydronic Specialties.
- G. Section 260583 - Wiring Connections.

1.03 REFERENCE STANDARDS

- A. AHRI 550/590 (I-P) - Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle; 2020.
- B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.
- C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.
- B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- C. Manufacturer's Certificate: Certify that components furnished but not produced by manufacturer meet or exceed manufacturer's requirements.
- D. Manufacturer's Performance Data: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum condenser water temperature for water-cooled chillers and at specified and minimum outdoor air temperature for air-cooled chillers.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written installation instructions for rigging, unloading, and transporting units.
- B. Deliver units to the job site completely assembled and charged with refrigerant and oil by manufacturer.

1.07 WARRANTY

- A. Manufacturer's Warranty: Provide minimum five year warranty to include coverage for materials and labor for compressor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carrier Corporation; _____: www.carrier.com/#sle.
- B. Trane Technologies, PLC; _____: www.trane.com/#sle.

2.02 CHILLER PERFORMANCE REQUIREMENTS

- A. Chiller CH-1: Water-Cooled.
 - 1. Basis of Design: Carrier.
 - 2. Refrigerant: R-410A or R-134A.
 - 3. Evaporator:
 - a. Water Based Fouling Factor: 0.00010 sq ft hr degrees F per Btu.
 - 4. Packaged Water-Cooled Condenser:
 - a. Water Based Fouling Factor: 0.00025 sq ft hr degrees F per Btu.

2.03 AIR-COOLED SCROLL WATER CHILLERS

- A. Chillers: Factory assemble and test chiller consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, starters, and microprocessor-based controls.
 - 1. Rating: AHRI 550/590 (I-P).
 - 2. Safety: UL 1995 and ASHRAE Std 15.
 - 3. Construction & Testing: ASME BPVC-VIII-1 as applicable for construction type.
 - 4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. or testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.
 - 5. Energy Efficiency: ASHRAE Std 90.1.
 - 6. Enclosures:
 - a. Frame:
 - 1) Heavy-gauge steel.
 - 2) Factory apply hot-dipped galvanized or air-dried paint finish.
 - b. Steel Chiller Cabinets:
 - 1) Factory apply baked-on enamel or baked-on powder paint finish.
 - c. Electrical Equipment: NEMA EN 10250 or UL 1995 as applicable.

2.04 COMPRESSORS AND EVAPORATOR

- A. Compressors: Hermetic scroll type.
 - 1. Unit: Fully hermetic type with multiple, direct-drive compressors with discharge and suction service valves.
 - 2. Vibration Control: Factory installed internal isolators or field installed external isolators.
 - 3. Oil Lubrication System: Initial oil charge, oil sump, heater, oil level, and sight glass.

4. Capacity Reduction System: Compressor staging with control down to 12 percent of full load without the activation of hot gas by-pass.
5. Motor: 3,600 or 3,500 rpm, suction gas-cooled, with thermal or current overload protection.
- B. Evaporator: Provide shell and tube or brazed plate type.
 1. Shell and Tube Type:
 - a. Shell, removable heads, and tube support sheets constructed of carbon steel.
 - b. Tubes: Mechanically expand and fasten, seamless, externally or internally enhanced, copper tubes into intermediate tube support sheets along the length of shell to avoid contact and relative motion between tubes.
 - c. Refrigerant Working-Side Pressure Rating: 225 psig minimum.
 - d. Water Working-Side Pressure Rating: ____ psig minimum.
 - e. Provide with flanged or grooved connections.
 - f. Insulation for all cold surfaces.
 - 1) Insulation is factory or field installed on shell, connections, and suction piping.
 - 2) 0.75 inches minimum thickness, closed cell, expanded polyvinyl chloride, polyurethane, or vinyl nitrate polymer insulation with a maximum k value of 0.28.
 - g. Provide factory or field installed vents and water drain connections on evaporator or piping.
 - h. Provide factory or field installed fittings for temperature control sensors on evaporator or piping.
 - i. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F.
 2. Brazed Plate Type:
 - a. Plate Material: 316 stainless steel.
 - b. Refrigerant Working-Side Pressure Rating: 430 psig minimum.
 - c. Water Working-Side Pressure Rating: 150 psig minimum.
 - d. Provide with flanged or grooved connections.
 - e. Insulation for all cold surfaces.
 - 1) Insulation is factory or field installed on evaporator, connections, and suction piping.
 - 2) 0.75 inches minimum thickness, closed cell, expanded polyvinyl chloride, polyurethane, or Armaflex II insulation with a maximum k value of 0.28.
 - f. Provide factory or field installed vents and water drain connections on evaporator or piping.
 - g. Provide factory or field installed fittings for temperature control sensors on evaporator or piping.
 - h. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F.

2.05 WATER-COOLED CONDENSER

- A. Provide shell and tube or brazed plate type.
 1. Shell and Tube Type:
 - a. Shell, removable heads, and tube support sheets constructed of carbon steel.
 - b. Tubes: Mechanically expand and fasten, seamless, externally or internally enhanced, copper tubes into intermediate tube support sheets along the length of shell to avoid contact and relative motion between tubes.
 - c. Refrigerant Working-Side Pressure Rating: 500 psig minimum.
 - d. Water Working-Side Pressure Rating: 150 psig minimum.
 - e. Provide with flanged or grooved connections.
 2. Brazed Plate Type:
 - a. Plate Material: 316 stainless steel.
 - b. Refrigerant Working-Side Pressure Rating: 505 psig minimum.
 - c. Water Working-Side Pressure Rating: 300 psig minimum.

- d. Provide with flanged or grooved connections.

2.06 AIR-COOLED CONDENSER AND FANS

- A. Provide finned-tube, brazed one-piece, or flat tube-plate-manifold type.
 - 1. Finned-tube Type:
 - a. Mechanically bond aluminum fins to copper tubing and protect with corrosion resistant materials or coatings.
 - b. Clean, dehydrate and test.
- B. Coil Guards: Provide corrosion proof, louvered panels, heavy gauge wire panels, or grilles, factory installed. Provide coil protection for shipping by enclosing entire condenser coil with heavy plastic to prevent coil damage during shipping or rigging.
- C. Fans and Motors:
 - 1. Fans: Dynamically balanced propeller, shrouded-axial, or airfoil type fans of reinforced polymer or glass fiber reinforced composite corrosion resistant construction equipped with sealed, permanently lubricated ball bearings.
 - 2. Discharge Fan Guards: Corrosion resistant, heavy gauge, steel wire.
 - 3. Discharge Direction: Vertical.
 - 4. Motors: Direct drive, totally enclosed for outdoor use with current overload protection.

2.07 REFRIGERATION CIRCUITS

- A. Provide multiple independent refrigeration circuit(s) with one or multiple compressor(s) per circuit.
- B. Provide liquid line shut-off valve, filter-drier, expansion valve, and refrigerant relief device for each independent circuit.

2.08 INTEGRATED MICROPROCESSOR BASED DDC CONTROLS PACKAGE

- A. Pre-wire, assemble, factory mount, and test operating and safety control system consisting of a digital display or gauges, on-auto-off switch, motor starters, disconnect switches, power and control wiring. Provide controls, monitoring, programmable set-points, alarms, and BAS as defined below:
 - 1. Automatic Adjustable Operating Controls:
 - a. Temperature of chilled water leaving chiller.
 - b. Chiller system capacity control based on set-points and system load.
 - c. Compressor short-cycling prevention.
 - d. Lead/lag for multiple compressors.
 - e. Automatic reset on power source failure.
 - f. Load limiting.
 - 2. Normal Operation Monitoring and Open Cover-less Displays:
 - a. Hours of operation.
 - b. Suction and discharge refrigerant pressures.
 - c. Automatic diagnostics.
 - d. Number of starts.
 - e. On/off compressor status.
 - f. Entering and leaving chilled water temperatures.
 - g. Status of operation.
 - h. Condenser water entering and leaving temperatures.
 - i. Weekly purge cycle totalization if applicable.
 - j. Oil pressure.
 - 3. Set-Points:
 - a. Leaving chilled water temperature.
 - b. Date/time.
 - c. Leaving condenser water temperature.

4. Automatic Chiller Shut-Down Safety Controls and Alarm:
 - a. Automatic Reset:
 - 1) Chilled water flow interlock.
 - 2) Voltage protection (over/under).
 - 3) Phase reversal protection.
 - b. Manual Reset:
 - 1) Evaporator low pressure.
 - 2) High motor winding temperature.
 - 3) Low chilled water temperature.
 - 4) Low chilled water flow.
 - 5) High condenser refrigerant discharge pressure.
 - 6) Motor current overload and phase loss.
 - 7) Low oil flow.
 - c. Remote Alarm: Activate remote, audible bell upon safety shutdown of chiller.
5. Building Automation System (BAS) Communications via Shielded Cable:
 - a. Minimum Data Transmission to BAS:
 - 1) All system operating conditions.
 - 2) Capacity control information.
 - 3) Safety shutdown conditions.
 - b. Minimum Operating Commands from BAS:
 - 1) Remote unit start/stop.
 - 2) Remote condenser water reset.
 - 3) Remote chilled water reset.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.
- C. Install units on vibration isolators.
- D. Connect to electrical service.
- E. Connect to chilled water piping.
- F. Arrange piping for easy dismantling to permit tube cleaning and removal.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Perform factory startup of the chiller by factory trained and authorized servicing technicians confirming equipment has been correctly installed prior to equipment becoming operational and covered under the manufacturer's warranty.
- B. Supply initial charge of refrigerant and oil if not completely factory charged.
- C. Demonstrate system operations and verify specified performance.

3.03 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
 1. Use operation and maintenance data as reference during demonstration.
 2. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Owner's personnel on operation and maintenance of system.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of two hours of training.
3. Instructor: Manufacturer's training personnel.
4. Location: At project site.

END OF SECTION

SECTION 237313
MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Casing construction.
- B. Fan section.
- C. Coil section.
- D. Filter and air cleaner section.
- E. Damper section.

1.02 RELATED REQUIREMENTS

- A. Section 233413 - Axial HVAC Fans.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addendum (2011).
- C. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- D. AMCA 99 - Standards Handbook; 2016.
- E. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.
- F. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.
- H. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- I. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012 (Reapproved 2015).
- J. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Errata (2020).
- K. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
- O. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2021.
- P. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Published Literature: Indicate dimensions, weights, capacities, ratings, gauges and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
 - 3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.

4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.07 WARRANTY

- A. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carrier Corporation: www.carrier.com/#sle.
- B. Trane Inc: www.trane.com/#sle.
- C. York International Corporation / Johnson Controls Inc: www.york.com/#sle.
- D. Temtrol.

2.02 REGULATORY REQUIREMENTS

- A. Comply with NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

2.03 CASING CONSTRUCTION

- A. Full Perimeter Base Rail:
1. Construct of galvanized steel.
 2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.
- B. Casing:
1. Construct of one piece, insulated, double wall panels.
 2. Provide mid-span, no through metal, internal thermal break.
 3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
 4. Casing Air Pressure Performance Requirements:
 - a. Able to withstand up to 8 inches w.g. positive or negative static pressure with leakage no more than 1% of design airflow.
 - b. Not to exceed 0.0042 inches per inch deflection at 1.5 times design static pressure up to a maximum of plus 8 inches w.g. in positive pressure sections and minus 8 inches w.g. in negative pressure sections.

- C. Access Doors:
 - 1. Construction, thermal and air pressure performance same as casing.
 - 2. Provide surface mounted handles on hinged, swing doors.
- D. Outside Air and Exhaust Air Weather Hood:
 - 1. Fabricate from same material as casing outer panel.
 - 2. Extend hood past perimeter of unit casing opening so as not to obstruct airflow path.
 - 3. Paint hoods with same finish as external surface of outdoor units.
 - 4. Provide inlet hood for each fresh air damper with a sine wave moisture eliminator to prevent entrainment of water into the unit from outside air.
 - 5. Provide exhaust hoods for each exhaust air opening.
 - 6. Size each hood for 100 percent of nominal fresh air damper capacities.
 - 7. Protect each hood with bird screen to prevent nesting at intake or exhaust air flow paths.
- E. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.
- F. Casing Leakage: Seal joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.
- G. Insulation:
 - 1. Provide minimum thermal thickness of R-19 R throughout.
 - 2. Completely fill panel cavities in each direction to prevent voids and settling.
 - 3. Comply with NFPA 90A.
- H. Drain Pan Construction:
 - 1. Provide cooling coil sections with an insulated, double wall, stainless steel drain pan complying with ASHRAE Std 62.1 for indoor air quality and sufficiently sized to collect all condensate.
 - 2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
 - 3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
 - 4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.
- I. Louvers: Stationary, of galvanized steel, 4 inch deep with plenum, nylon bearings, 1/2 inch mesh, 0.04 inch galvanized wire bird screen in aluminum frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500-L. Furnish adjustable louvers with hollow vinyl bulb edging on blades and foam side stops to limit leakage to maximum 2 percent at 4 inch wg differential pressure when sized for 2000 fpm face velocity.
- J. Marine Lights:
 - 1. Provide factory-mounted, water- and dust-resistant LED fixture(s) in all accessible sections.
 - a. Non-ferrous metal housing.
 - b. Glass or polycarbonate lens.
 - c. Factory wired to a single switch within factory provided service module.
 - 2. Provide factory installed service module including GFCI receptacle independent from load side; designed to receive power from field supplied 120 volt source.
- K. Finish:

2.04 FAN SECTION

- A. Type: Forward curved, single width, single inlet, centrifugal plug type fan, in compliance with AMCA 99. Refer to Section 233413
- B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.

- C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.
- D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.
- E. External Motor Junction Box: Factory mount NEMA 4 external junction box and connect to extended motor leads from internally mounted motors.
- F. Motor Wiring Conduit: Factory wire fan motor wiring to the unit mounted starter-disconnect, variable frequency drive, external motor junction box, and _____.
- G. Fan Accessories:
 - 1. Discharge dampers.
 - 2. Damper operator.
- H. Flexible Duct Connections:
 - 1. For separating fan, coil, and adjacent sections.
- I. Drives:
 - 1. Comply with AMCA 99.
 - 2. Bearings: Heavy duty pillow block type, ball bearings, with ABMA STD 9 L-10 life at 50,000 hours.
 - 3. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
 - 4. Direct drive.
 - 5.

2.05 COIL SECTION

- A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
- B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.
- C. Eliminators: Three break of galvanized steel, mounted over drain pan.
- D. Air Coils:
 - 1. Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410.
- E. Fabrication:
 - 1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
 - 2. Fins: Aluminum.
 - 3. Casing: Die formed channel frame of galvanized steel.
- F. Water Heating Coils:
 - 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 - 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.
- G. Water Cooling Coils:
 - 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 - 2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.

2.06 FILTER AND AIR CLEANER SECTION

- A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.
- B. Throwaway Filters:

1. Media: 2 inch fiberglass with rigid supporting mesh across the leaving face, capable of operating up to a maximum of 500 fpm without loss of efficiency and holding capacity.
 2. Frame: Rigid.
 3. Minimum Efficiency Reporting Value: 13 MERV when tested in accordance with ASHRAE Std 52.2.
- C. Differential Pressure Gauge:
1. Provide factory installed dial type differential pressure gauge, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
 2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F to 120 degrees F.

2.07 DAMPER SECTION

- A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor, return, and exhaust air.
- B. Damper Blades:
1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on each blade.
 2. Self-lubricating stainless steel or synthetic sleeve bearings.
 3. Comply with ASHRAE Std 90.1 I-P for rated maximum leakage rate.
 4. Provide leakage testing and pressure ratings in compliance with AMCA 500-D test methods.
 5. Arrange in parallel or opposed-blade configuration.
- C. Barometric Relief Dampers:
1. Frame: Roll formed galvanized steel.
 2. Blades: Roll formed galvanized steel.
 3. Blade Seals: Extruded vinyl, mechanically attached to the blade edge.
 4. Material:

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Bolt sections together with gaskets.
- C. Isolate fan section with flexible duct connections.
- D. Install flexible duct connections between fan inlet and discharge ductwork and air handling unit sections. Ensure that metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- E. Provide fixed sheaves required for final air balance.
- F. Make connections to coils with unions or flanges.
- G. Hydronic Coils:
1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
 2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
 3. Locate water supply at bottom of supply header and return water connection at top.
 4. Provide manual air vents at high points complete with stop valve.
 5. Ensure water coils are drainable and provide drain connection at low points.

3.02 SYSTEM STARTUP

- A. Provide manufacturer's field representative to perform systems startup.
- B. Adjust for proper operation within manufacturer's published tolerances.

3.03 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.

END OF SECTION

**SECTION 260505
SELECTIVE DEMOLITION FOR ELECTRICAL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Report discrepancies to Owner before disturbing existing installation.
- C. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- C. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Repair adjacent construction and finishes damaged during demolition and extension work.
- E. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

3.04 CLEANING AND REPAIR

- A. See Section 017419 - Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.
- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION

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SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Heat shrink tubing.
- F. Wire pulling lubricant.
- G. Cable ties.
- H. Firestop sleeves.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2024.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.
- I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- N. UL 183 - Manufactured Wiring Systems; Current Edition, Including All Revisions.
- O. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

- P. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- Q. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- S. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.

- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 260526.
- H. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- I. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- J. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
 - 2. Control Circuits: 14 AWG.
- K. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- L. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - c. Equipment Ground, All Systems: Green.
 - d. Isolated Ground, All Systems: Green with yellow stripe.
 - e. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 - 1. Copper Building Wire:
 - a. Cerro Wire LLC.
 - b. Encore Wire Corporation.
 - c. General Cable Technologies Corporation.
 - d. Service Wire Co.
 - e. Southwire Company.

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- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

2.04 METAL-CLAD CABLE

- A. Manufacturers:
 - 1. AFC Cable Systems Inc.
 - 2. Encore Wire Corporation.
 - 3. Service Wire Co.
 - 4. Southwire Company.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Grounding: Full-size integral equipment grounding conductor.
 - 1. Provide additional isolated/insulated grounding conductor where indicated or required.
- G. Armor: Steel, interlocked tape.

2.05 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 260526.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 - 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 - 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 - 6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.

- 7. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- F. Mechanical Connectors: Provide bolted type or set-screw type.
 - 1. Manufacturers:
 - a. Burndy LLC.
 - b. IlSCO.
 - c. Thomas & Betts Corporation.
- G. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 - 1. Manufacturers:
 - a. Burndy LLC.
 - b. IlSCO.
 - c. Thomas & Betts Corporation.
- H. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 - 1. Manufacturers:
 - a. Burndy LLC.
 - b. IlSCO.
 - c. Thomas & Betts Corporation.

2.06 ACCESSORIES

- A. Electrical Tape:
 - 1. Manufacturers:
 - a. 3M.
 - b. Plymouth Rubber Europa.
 - 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 - 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 - 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 - 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 - 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.
- E. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - 1. Products:

- a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Circuiting Requirements:
 1. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 2. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 3. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
 4. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
 5. Provide oversized neutral/grounded conductors where indicated and as specified below.
 - a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
 - b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install metal-clad cable (Type MC) in accordance with NECA 120.
- E. Installation in Raceway:
 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- H. Terminate cables using suitable fittings.
 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- I. Install conductors with a minimum of 12 inches of slack at each outlet.
- J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- L. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 3. Wet Locations: Use heat shrink tubing.
- N. Insulate ends of spare conductors using vinyl insulating electrical tape.
- O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- P. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

END OF SECTION

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SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Ground enhancement material.
- G. Ground access wells.

1.02 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA GR 1 - Ground Rod Electrodes and Ground Rod Electrode Couplings; 2017.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings:
 - 1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- E. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 - 3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 - 4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
 - 5. Ground Ring:
 - a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.

- b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.
 - c. Provide ground enhancement material around conductor where indicated.
 - d. Provide connection from ground ring conductor to:
 - 1) Perimeter columns of metal building frame.
 6. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground enhancement material around electrode where indicated.
 - e. Provide ground access well for each electrode.
 7. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 8. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
 9. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
- E. Service-Supplied System Grounding:
 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- F. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
 1. Provide grounding electrode system for each separate building or structure.
 2. Provide equipment grounding conductor routed with supply conductors.
 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- G. Separately Derived System Grounding:
 1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
 - c. Generators, when neutral is switched in the transfer switch.
 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.

3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
 4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
 5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
 6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
 7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- H. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 - c. Metal process piping.
 8. Provide bonding for interior metal air ducts.
 9. Provide bonding for metal building frame.
 10. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
- I. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
 2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
 3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make

any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

- J. Communications Systems Grounding and Bonding:
 - 1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
 - 2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- C. Connectors for Grounding and Bonding:
 - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - a. Exceptions:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.
 - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.
 - 4. Manufacturers - Mechanical and Compression Connectors:
 - a. Advanced Lightning Technology (ALT).
 - b. Burndy LLC.
 - c. Harger Lightning & Grounding.
 - d. Thomas & Betts Corporation.
 - 5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy LLC.
 - b. Cadweld, a brand of Erico International Corporation.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC.
- D. Ground Bars:
 - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 - 2. Size: As indicated.
 - 3. Holes for Connections: As indicated or as required for connections to be made.
 - 4. Manufacturers:
 - a. Advanced Lightning Technology (ALT).
 - b. Erico International Corporation.

- c. Harger Lightning & Grounding.
- E. Ground Rod Electrodes:
 - 1. Comply with NEMA GR 1.
 - 2. Material: Copper-bonded (copper-clad) steel.
 - 3. Size: 3/4 inch diameter by 10 feet in length, unless otherwise indicated.
 - 4. Manufacturers:
 - a. Advanced Lightning Technology (ALT).
 - b. Erico International Corporation.
 - c. Galvan Industries, Inc.
 - d. Harger Lightning & Grounding.
- F. Ground Access Wells:
 - 1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
 - 2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
 - a. Round Wells: Not less than 8 inches in diameter.
 - b. Rectangular Wells: Not less than 12 by 12 inches.
 - 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
 - 4. Cover: Factory-identified by permanent means with word "GROUND".
 - 5. Manufacturers:
 - a. Advanced Lightning Technology (ALT).
 - b. Erico International Corporation.
 - c. Harger Lightning & Grounding.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
 - 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

- E. Identify grounding and bonding system components in accordance with Section 260553.

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SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- D. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- E. Section 265600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 2. Conduit Clamps: Bolted type unless otherwise indicated.
 - 3. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation.
 - b. Erico International Corporation.
 - c. O-Z/Gedney, a brand of Emerson Electric Co.
 - d. Thomas & Betts Corporation.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
 - 1. Manufacturers:

- a. Cooper Crouse-Hinds, a division of Eaton.
 - b. Erico International Corporation.
 - c. O-Z/Gedney, a brand of Emerson Electric Co.
 - d. Thomas & Betts Corporation.
- D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 1. Comply with MFMA-4.
 2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
 3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
 6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation.
 - b. Thomas & Betts Corporation.
 - c. Unistrut, a brand of Atkore International Inc.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
 - c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
 - e. Outlet Boxes: 1/4 inch diameter.
 - f. Luminaires: 1/4 inch diameter.
- F. Anchors and Fasteners:
 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 4. Hollow Masonry: Use toggle bolts.
 5. Hollow Stud Walls: Use toggle bolts.
 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 7. Sheet Metal: Use sheet metal screws.
 8. Wood: Use wood screws.
 9. Plastic and lead anchors are not permitted.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Conduit Support and Attachment: Also comply with Section 260533.13.
- I. Box Support and Attachment: Also comply with Section 260533.16.
- J. Interior Luminaire Support and Attachment: Also comply with Section 265100.
- K. Exterior Luminaire Support and Attachment: Also comply with Section 265600.
- L. Secure fasteners according to manufacturer's recommended torque settings.
- M. Remove temporary supports.

END OF SECTION

SECTION 260533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Intermediate metal conduit (IMC).
- C. PVC-coated galvanized steel rigid metal conduit (RMC).
- D. Flexible metal conduit (FMC).
- E. Liquidtight flexible metal conduit (LFMC).
- F. Electrical metallic tubing (EMT).
- G. Rigid polyvinyl chloride (PVC) conduit.
- H. Liquidtight flexible nonmetallic conduit (LFNC).
- I. Conduit fittings.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260533.16 - Boxes for Electrical Systems.
- F. Section 260533.23 - Surface Raceways for Electrical Systems.
- G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2025.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

- M. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- N. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- O. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- Q. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- R. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- S. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
- T. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Shop Drawings:
 - 1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
 - 2. Include proposed locations of roof penetrations and proposed methods for sealing.
- D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
 - 3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 - 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 - 5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
 - 6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
 - 7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- D. Embedded Within Concrete:
 - 1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 - 2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 - 3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 - 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- K. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.
- L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- M. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), aluminum rigid metal conduit, or PVC-coated galvanized steel rigid metal conduit.
- N. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
 - 1. Maximum Length: 6 feet.
- O. Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit.
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 - 3. Maximum Length: 6 feet unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.02 CONDUIT REQUIREMENTS

- A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4 inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
 - 3. Control Circuits: 1/2 inch (16 mm) trade size.
 - 4. Underground, Interior: 3/4 inch (21 mm) trade size.
 - 5. Underground, Exterior: 1 inch (27 mm) trade size.
- D. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International.
 - 2. Nucor Tubular Products.
 - 3. Western Tube, a division of Zekelman Industries.
 - 4. Wheatland Tube, a division of Zekelman Industries.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc.
 - b. O-Z/Gedney, a brand of Emerson Electric Co.
 - c. Thomas & Betts Corporation.
 - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.

4. Material: Use steel or malleable iron.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
 1. Allied Tube & Conduit, a division of Atkore International.
 2. Nucor Tubular Products.
 3. Western Tube, a division of Zekelman Industries.
 4. Wheatland Tube, a division of Zekelman Industries.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
 1. Manufacturers:
 - a. Bridgeport Fittings Inc.
 - b. O-Z/Gedney, a brand of Emerson Electric Co.
 - c. Thomas & Betts Corporation.
 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 4. Material: Use steel or malleable iron.
 5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 1. Thomas & Betts Corporation.
 2. Robroy Industries.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- D. Interior Coating: Urethane, minimum thickness of 2 mil.
- E. PVC-Coated Fittings:
 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 4. Material: Use steel or malleable iron.
 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
 6. Interior Coating: Urethane, minimum thickness of 2 mil.
- F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.06 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 1. AFC Cable Systems, Inc.
 2. Electri-Flex Company.
 3. International Metal Hose.

- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc.
 - b. O-Z/Gedney, a brand of Emerson Electric Co.
 - c. Thomas & Betts Corporation.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.

2.07 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. Electri-Flex Company.
 - 3. International Metal Hose.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc.
 - b. O-Z/Gedney, a brand of Emerson Electric Co.
 - c. Thomas & Betts Corporation.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.

2.08 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International.
 - 2. Nucor Tubular Products.
 - 3. Western Tube, a division of Zekelman Industries.
 - 4. Wheatland Tube, a division of Zekelman Industries.
- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc.
 - b. O-Z/Gedney, a brand of Emerson Electric Co.
 - c. Thomas & Betts Corporation.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter type connectors and couplings.
 - 5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
 - 6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.09 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 - 1. Cantex Inc.
 - 2. Carlon, a brand of Thomas & Betts Corporation.
 - 3. JM Eagle.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. Electri-Flex Company.
 - 3. International Metal Hose.
- B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- G. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.
- H. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - 3. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.

4. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 5. Arrange conduit to maintain adequate headroom, clearances, and access.
 6. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
 7. Arrange conduit to provide no more than 150 feet between pull points.
 8. Route conduits above water and drain piping where possible.
 9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 11. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
- I. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 3. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 4. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 5. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
 6. Use of wire for support of conduits is not permitted.
 7. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- J. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- K. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.

5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
 8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- L. Underground Installation:
1. Provide trenching and backfilling in accordance with Section 312316.13.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
 3. Provide underground warning tape in accordance with Section 260553 along entire conduit length for service entrance where not concrete-encased.
- M. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Secure conduits to prevent floating or movement during pouring of concrete.
- N. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.
- O. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
 4. Where conduits are subject to earth movement by settlement or frost.
- P. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- Q. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- R. Provide grounding and bonding in accordance with Section 260526.

END OF SECTION

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SECTION 260533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Floor boxes.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260533.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- F. Section 262726 - Wiring Devices:
 - 1. Wall plates.
- G. Section 262813 - Fuses: Spare fuse cabinets.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use suitable concrete type boxes where flush-mounted in concrete.
 4. Use suitable masonry type boxes where flush-mounted in masonry walls.

5. Use raised covers suitable for the type of wall construction and device configuration where required.
 6. Use shallow boxes where required by the type of wall construction.
 7. Do not use "through-wall" boxes designed for access from both sides of wall.
 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
 12. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
 13. Wall Plates: Comply with Section 262726.
 14. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation.
 - b. Hubbell Incorporated; Bell Products.
 - c. Hubbell Incorporated; RACO Products.
 - d. O-Z/Gedney, a brand of Emerson Electric Co.
 - e. Thomas & Betts Corporation.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
- D. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 262726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
 2. Use cast iron floor boxes within slab on grade.
 3. Use sheet-steel or cast iron floor boxes within slab above grade.
 4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
 5. Manufacturer: Same as manufacturer of floor box service fittings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.
 - 4. Locate boxes so that wall plates do not cross masonry joints.
 - 5. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 6. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 - 7. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
 - 8. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- H. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
- I. Install boxes plumb and level.
- J. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- K. Install boxes as required to preserve insulation integrity.
- L. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- O. Close unused box openings.

- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 260526.

END OF SECTION

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SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 260573 - Power System Studies: Arc flash hazard warning labels.
- C. Section 262726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- C. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchgear:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use identification nameplate to identify main and tie devices.
 - 5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Switchboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use identification nameplate to identify main overcurrent protective device.
 - 5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - c. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - d. Transformers:
 - 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify load(s) served. Include location when not within sight of equipment.
 - e. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - f. Time Switches:
 - 1) Identify load(s) served and associated circuits controlled. Include location.
 - g. Enclosed Contactors:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
 - 4) Identify coil voltage.

- 5) Identify load(s) and associated circuits controlled. Include location.
- h. Centralized Emergency Lighting Inverters:
 - 1) Identify input and output voltage and phase.
 - 2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location.
- i. Transfer Switches:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
3. Emergency System Equipment:
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
5. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
6. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
7. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 - b. Motor control centers.
 - c. Elevator control panels.
8. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
 - c. Service Equipment: Include the following information in accordance with NFPA 70.
 - 1) Nominal system voltage.
 - 2) Available fault current.
 - 3) Clearing time of service overcurrent protective device(s).

- 4) Date label applied.
 9. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
 10. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 11. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 12. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 3. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
 4. Use underground warning tape to identify direct buried cables.
- C. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
- D. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
 2. Use voltage markers or color coded boxes to identify systems other than normal power system.
 - a. Color-Coded Boxes: Field-painted in accordance with Section 099123 and 099113 per the same color code used for raceways.
 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.
- E. Identification for Devices:
1. Wiring Device and Wallplate Finishes: Comply with Section 262726.
 2. Use identification label to identify fire alarm system devices.
 3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Manufacturers:
 - a. Brimar Industries, Inc.
 - b. Kolbi Pipe Marker Co.
 - c. Seton Identification Products.
 2. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.

3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
1. Manufacturers:
 - a. Brady Corporation.
 - b. Brother International Corporation.
 - c. Panduit Corp.
 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
 2. Legend:
 - a. System designation where applicable:
 - 1) Emergency Power System: Identify with text "EMERGENCY".
 - 2) Fire Alarm System: Identify with text "FIRE ALARM".
 - b. Equipment designation or other approved description.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height:
 - a. System Designation: 1 inch.
 - b. Equipment Designation: 1/2 inch.
 - c. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
 5. Color:
 - a. Normal Power System: White text on black background.
 - b. Emergency Power System: White text on red background.
 - c. Fire Alarm System: White text on red background.
- D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/4 inch.
 5. Color: Black text on white background unless otherwise indicated.
- E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.

2. Legend: Power source and circuit number or other designation indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.
- G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Load controlled or other designation indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.
- H. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Designation indicated and device zone or address.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

- A. Manufacturers:
1. Brady Corporation.
 2. HellermannTyton.
 3. Panduit Corp.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

- A. Manufacturers:
1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Seton Identification Products.
- B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- D. Minimum Size:
1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
 2. Markers for System Identification:

- a. Emergency Power System: Text "EMERGENCY".
- F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Seton Identification Products.
- B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- D. Legend: Type of service, continuously repeated over full length of tape.
- E. Color:
 - 1. Tape for Buried Power Lines: Black text on red background.
 - 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 WARNING SIGNS AND LABELS

- A. Manufacturers:
 - 1. Brimar Industries, Inc.
 - 2. Clarion Safety Systems, LLC.
 - 3. Insite Solutions, LLC.
- B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- C. Warning Signs:
 - 1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
 - 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
 - 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- D. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 - 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.

7. Conduits: Legible from the floor.
 8. Boxes: Outside face of cover.
 9. Conductors and Cables: Legible from the point of access.
 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
 - D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
 - E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
 - F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
 - G. Secure rigid signs using stainless steel screws.
 - H. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

**SECTION 260573
POWER SYSTEM STUDIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
 - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.02 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- B. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).
- C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).
- D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
- E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.
- F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).
- G. NEMA MG 00001 - Motors and Generators; 2024.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
 - 2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Study preparer's qualifications.
- C. Study reports, stamped or sealed and signed by a Professional Engineer.
- D. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
 - 1. Include characteristic time-current trip curves for protective devices.
 - 2. Include impedance data for busway.
 - 3. Include impedance data for engine generators.
 - 4. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 - 5. Include documentation of listed series ratings upon request.
 - 6. Identify modifications made in accordance with studies that:
 - a. Can be made at no additional cost to Owner.
 - b. As submitted will involve a change to the contract sum.
- E. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- F. Site-specific arc flash hazard warning labels.
- G. Field quality control reports.
- H. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- I. Project Record Documents: Revise studies as required to reflect as-built conditions.
 - 1. Include hard copies with operation and maintenance data submittals.
 - 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.06 POWER SYSTEM STUDIES

- A. Scope of Studies:
 - 1. Perform analysis of both new and directly affected existing portions of electrical distribution system.
 - 2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
 - 3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
 - a. Known Operating Modes:
 - 1) Utility as source.
 - 2) Generator as source.
 - 3) Bus tie breaker open/close positions.
- B. General Study Requirements:
 - 1. Comply with NFPA 70.
 - 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
 - 1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
 - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.

- 1) Obtain up-to-date information from Utility Company.
 - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
 - c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 00001 code letter designation.
 - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - e. Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
 - g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
 2. Existing Installations:
 - a. Collect data on existing electrical distribution system necessary for completion of studies, including but not limit to field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.
- D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
 2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
 - a. Maximum utility fault currents.
 - b. Maximum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
 3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.
 2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
 3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors.
- F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
 3. Calculate the arc-flash protection boundary and incident energy at the service, extend down to the system overcurrent protective devices as follows:
 - To normal system low-voltage load buses where fault current is 10kA or less.
 - To three phase motors per electrical one-line diagram.
 4. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.

5. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
 - a. Maximum and minimum utility fault currents.
 - b. Maximum and minimum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- G. Study Reports:
 1. General Requirements:
 - a. Identify date of study and study preparer.
 - b. Identify study methodology and software product(s) used.
 - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
 - d. Identify base used for per unit values.
 - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
 - f. Include conclusions and recommendations.
 2. Short-Circuit Study:
 - a. For each scenario, identify at each bus location:
 - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
 - 2) Fault point X/R ratio.
 - 3) Associated equipment short circuit current ratings.
 - b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
 3. Protective Device Coordination Study:
 - a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
 - b. For each graph include (where applicable):
 - 1) Partial single-line diagram identifying the portion of the system illustrated.
 - 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
 - 3) Conductors: Damage curves.
 - 4) Transformers: Inrush points and damage curves.
 - 5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
 - 6) Motors: Full load current, starting curves, and damage curves.
 - 7) Capacitors: Full load current and damage curves.
 - c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
 - 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
 - 2) Include ground fault pickup and delay.
 - 3) Include fuse ratings.
 - 4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
 - d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
 4. Arc Flash and Shock Risk Assessment:
 - a. For the worst case for each scenario, identify at each bus location:
 - 1) Calculated incident energy and associated working distance.

- 2) Calculated arc flash boundary.
 - 3) Bolted fault current.
 - 4) Arcing fault current.
 - 5) Clearing time.
 - 6) Arc gap distance.
- b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

1.07 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in the preparation of studies of similar type and complexity using specified computer software.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
1. Acceptable Software Products:
 - a. EasyPower LLC.
 - b. ETAP/Operation Technology, Inc.
 - c. Power Analytics Corporation.
 - d. SKM Systems Analysis, Inc.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
1. Materials: Comply with Section 260553.
 2. Minimum Size: 4 by 6 inches.
 3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
 - a. Include orange header that reads "WARNING" unless otherwise indicated.
 - b. Include the following information:
 - 1) Arc flash boundary.
 - 2) Available incident energy and corresponding working distance.
 - 3) Site-specific PPE (personnel protective equipment) requirements.
 - 4) Nominal system voltage.
 - 5) Limited approach boundary.
 - 6) Restricted approach boundary.
 - 7) Equipment identification.
 - 8) Date calculations were performed.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install arc flash warning labels in accordance with Section 260553.

3.02 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Adjust equipment and protective devices for compliance with studies and recommended settings.
- C. Notify Engineer of any conflicts with or deviations from studies. Obtain direction before proceeding.
- D. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.03 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
 - 1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.
 - 3. Instructor: Representative of entity performing study.
 - 4. Location: At project site.

END OF SECTION

**SECTION 260583
WIRING CONNECTIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260533.13 - Conduit for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 262726 - Wiring Devices.
- E. Section 262816.16 - Enclosed Switches.
- F. Section 262913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.
- B. Wiring Devices: As specified in Section 262726.

- C. Flexible Conduit: As specified in Section 260533.13.
- D. Wire and Cable: As specified in Section 260519.
- E. Boxes: As specified in Section 260533.16.

2.02 EQUIPMENT CONNECTIONS

- A. Connection will be:
 - 1. Equipment Electrical Connection: Flexible conduit.
 - 2. Provide field-installed disconnect switch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes commissioning process requirements for Electrical systems, assemblies, and equipment.
- B. This project will have selected building systems commissioned. The equipment and systems to be commissioned are specified in "SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS".

1.2 RELATED SECTIONS

- A. SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS
- B. SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS
- C. SECTION 23 08 00 – COMMISSIONING OF HVAC SYSTEMS
- D. SECTION 28 08 00 – COMMISSIONING OF FIRE ALARM SYSTEMS

1.3 DEFINITIONS

- A. Refer to section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

1.4 SUBMITTALS

- A. Certificate Of Readiness, signed by the Contractor, certifying that systems, assemblies, equipment, components, and associated controls are ready for testing.
- B. Manufacturer's completed start-up reports for equipment and systems.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for details of Electrical contractor's responsibilities related to commissioning.
- B. Attend commissioning meetings.
- C. Provide information requested by the CxA for functional testing and for final commissioning documentation.
- D. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- E. Functional testing of systems will be carried out solely by Electrical contractor's personnel, under the direction of CxA. Provide experienced personnel, familiar with the systems being installed under this project.

- F. Provide all personnel, tools, materials, and equipment to support the commissioning process. Facilitate the coordination of the commissioning work with the CxP and incorporate commissioning activities into the master construction schedule.
- G. Incorporate all commissioning related activities into the construction schedule, ensuring that activities do not delay construction/project completion.
- H. Notify the Owner's Representative and the CxP in writing that equipment and system are ready for functional testing.
- I. Perform equipment startups using authorized manufacturing representatives.
- J. Provide written documentation to the CxP that equipment and system are fully operational and ready to be functionally performance tested.
- K. Perform commissioning tests at the direction of the CxP.
- L. Attend construction phase commissioning coordination meetings.
- M. Provide qualified personnel for participation in commissioning tests.
- N. Provide equipment, materials, and labor necessary to correct deficiencies found during the commissioning process.
- O. Participate in plumbing systems, assemblies, equipment, and component maintenance orientations and inspections as directed by the CxP.
- P. Provide information requested by the CxP for commissioning documentation and testing.
- Q. Perform all quality control functions to ensure equipment and system are installed properly. Ensure equipment and systems are brought to a state of readiness and full functionality prior to commencing the commissioning functional performance testing process.
- R. Provide qualified and owner approved representative to attend end of warranty testing.

1.6 CxA'S RESPONSIBILITIES

- A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS.
- B. CxA will direct commissioning testing.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in Division 26 Sections. Provide submittals, test data, inspector record, and certification to the CxA.

- B. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for detailed requirements of commissioning of Electrical systems.
- C. Perform commissioning tests at the direction of the CxA.
- D. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- E. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- F. Tests will be performed using design conditions whenever possible.

3.2 SYSTEM START-UP

- A. Contractor is solely responsible for system start-up. CxA may, at his discretion, witness start up procedures, but will not perform any Functional Testing of systems until Contractor has completed start-up and resolved all operating deficiencies, and has so certified.

3.3 TESTING PREPARATION

- A. Certify that Electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that Electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check safety cutouts, alarms, and interlocks with life-safety systems during each mode of operation.

3.4 FUNCTIONAL TESTING

- A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for detailed requirements of commissioning of Electrical systems.
- B. Provide measuring instruments and logging devices to record test data as directed by the CxA.

3.5 DEFERRED TESTING

- A. Initial commissioning will be done as soon as contract work is completed, though building may not be at full occupancy and equipment may not be at full loading.
- B. If adequate load may be artificially placed upon heating or cooling equipment, CxA, at his discretion, may perform functional testing during non-peak load periods. If testing cannot be carried out under these conditions to adequately verify system performance, testing will be deferred until such time as conditions are more satisfactory.

1. Contractor is to provide services of personnel and participate in deferred or seasonal testing process in the same manner as he would in non-seasonal testing.
2. If tests cannot be completed because of a deficiency outside the scope of the Electrical system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

3.6 RE-TESTING

- A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for detailed requirements of re-testing of Electrical systems.

3.7 SYSTEMS TO BE COMMISSIONED

- A. Reference Project Specification Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS for list of Electrical systems to be commissioned.

END OF SECTION

**SECTION 260923
LIGHTING CONTROL DEVICES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Outdoor motion sensors.
- C. Time switches.
- D. Outdoor photo controls.
- E. Daylighting controls.
- F. Lighting contactors.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
 - 1. Includes finish requirements for wall controls specified in this section.
- F. Section 265100 - Interior Lighting.
- G. Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices; 2020.
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- F. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- I. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.
- J. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- K. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.
- L. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections.
2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections.
4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections.
5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
 2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
- D. Operation and Maintenance Data: Include detailed information on device programming and setup.
- E. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.
- C. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.02 OCCUPANCY SENSORS

- A. Acceptable manufacturers as below, no substitutions is allowed.
 1. nLight by Acuity Brands.
 2. Nextlight.

3. Echoflex.
- B. All Occupancy Sensors:
 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
 - b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
 - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 - d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 7. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
- C. Wall Switch Occupancy Sensors:
 1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.
 - c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
 - d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - f. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
 2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- D. Wall Dimmer Occupancy Sensors:
 1. General Requirements:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode, dual technology type.

- b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - c. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
 - d. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
- E. Ceiling Mounted Occupancy Sensors:
 - 1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - 3. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.
- F. Power Packs for Low Voltage Occupancy Sensors:
 - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 - 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 - 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 - 4. Load Rating: As required to control the load indicated on drawings.

2.03 OUTDOOR MOTION SENSORS

- A. Acceptable manufacturers as below, no substitutions is allowed.
 - 1. nLight by Acuity.
 - 2. Nextlight.
 - 3. Echoflex.
- B. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.
- C. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.
- D. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.
- E. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.
- F. Integral Photocell: For dusk to dawn operation.
- G. Manual Override: Activated by switching power off to unit and then back on.
- H. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.
- I. Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.

2.04 TIME SWITCHES

- A. Acceptable manufacturers as below, no substitutions is allowed.
 - 1. nLight by Acuity.
 - 2. Nextlight
 - 3. Echoflex.
- B. Digital Electronic Time Switches:
 - 1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
 - 2. Program Capability:
 - a. 24-Hour Time Switches: Single channel, with same schedule for each day of the week and skip-a-day feature to omit selected days.
 - b. 7-Day Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days.
 - c. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
 - 3. Schedule Capacity: Not less than 16 programmable on/off operations.
 - 4. Provide automatic daylight savings time and leap year compensation.
 - 5. Provide power outage backup to retain programming and maintain clock.
 - 6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 - 7. Input Supply Voltage: As indicated on the drawings.
 - 8. Provide lockable enclosure; environmental type per NEMA EN 10250 as specified for the following installation locations:
 - a. Indoor clean, dry locations: Type 1.
 - b. Outdoor locations: Type 3R.

2.05 OUTDOOR PHOTO CONTROLS

- A. Acceptable manufacturers as below, no substitutions is allowed.
 - 1. nLight by Acuity.
 - 2. Nextlight.
 - 3. Echoflex.

2.06 DAYLIGHTING CONTROLS

- A. Acceptable manufacturers as below, no substitutions is allowed.
 - 1. nLight by Acuity.
 - 2. Nextlight.
 - 3. Echoflex.
- B. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.
- C. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
 - 1. Sensor Type: Filtered silicon photo diode.
 - 2. Sensor Range:
 - a. Indoor Photo Sensors: 5 to 100 footcandles.
 - b. Outdoor Photo Sensors: 5 to 250 footcandles.

- c. Atrium Photo Sensors: 200 to 2,500 footcandles.
 - d. Skylight Photo Sensors: 1,000 to 6,000 footcandles.
 - e. Open Loop Photo Sensors: 3 to 6,000 footcandles.
- 3. Finish: White unless otherwise indicated.
- D. Power Packs for Low Voltage Daylighting Control Modules:
 - 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 - 2. Input Supply Voltage: Dual rated for 120/277 V ac.
 - 3. Load Ratings: As required to control the load indicated on drawings.

2.07 LIGHTING CONTACTORS

- A. Manufacturers:
 - 1. ABB/GE
 - 2. Eaton Corporation.
 - 3. Schneider Electric; Square D Products.
- B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.
- C. Short Circuit Current Rating:
 - 1. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Enclosures:
 - 1. Comply with NEMA ICS 6.
 - 2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 - b. Outdoor Locations: Type 3R or Type 4.
 - 3. Finish: Manufacturer's standard unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.
- G. Provide required supports in accordance with Section 260529.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Occupancy Sensor Locations:
 - 1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- J. Outdoor Photo Control Locations:
 - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
 - 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.
- K. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.
- L. Daylighting Control Photo Sensor Locations:
 - 1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for proper control of respective room or area based on manufacturer's recommendations for installed devices.
 - 2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
 - 3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.
- M. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.

- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test time switches to verify proper operation.
- E. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.
- G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.04 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.
- F. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.05 COMMISSIONING

- A. See Section 019113 - General Commissioning Requirements for commissioning requirements.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION

SECTION 262413 SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- F. Section 262813 - Fuses: Fuses for fusible switches.
- G. Section 264300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less; 2023.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- K. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- L. UL 891 - Switchboards; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Service Entrance Switchboards:
1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
 2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
 3. Obtain Utility Company approval of switchboard prior to fabrication.
 4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Field Quality Control Test Reports.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Switchboards:
1. ABB/GE.
 2. Eaton Corporation.
 3. Schneider Electric; Square D Products.
 4. Siemens Industry, Inc.

2.02 SWITCHBOARDS

- A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- D. Service Entrance Switchboards:
 - 1. Listed and labeled as suitable for use as service equipment according to UL 869A.
 - 2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
 - 3. Comply with Utility Company requirements for electrical service.
- E. Service Conditions:
 - 1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude: Less than 6,600 feet.
 - b. Ambient Temperature:
 - 1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
 - 2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- F. Short Circuit Current Rating:
 - 1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- G. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- H. Bussing: Sized in accordance with UL 891 temperature rise requirements.
 - 1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
 - 2. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 - 3. Phase and Neutral Bus Material: Copper.
 - 4. Ground Bus Material: Copper.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
 - 1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
 - 2. Load Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Lug Type:
 - 1) Provide mechanical lugs unless otherwise indicated.
- J. Enclosures:
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
 - b. Outdoor Locations: Type 3R.

2. Finish: Manufacturer's standard unless otherwise indicated.
3. Enclosure Space Heaters:
 - a. Provide in each switchboard section installed outdoors and in unconditioned indoor spaces.
 - b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
 - c. Heater Control: Thermostat.
 - d. Heater Power Source: Provide connection to transformer factory-installed in switchboard or suitable external branch circuit as indicated or as required.
4. Outdoor Enclosures:
 - a. Enclosure Type: Non-walk-in type unless otherwise indicated.
 - b. Color: Manufacturer's standard.
 - c. Access Doors: Lockable, with all locks keyed alike.
- K. Future Provisions:
 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- L. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- M. Owner Metering:
 1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
 2. Measured Parameters:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase and neutral.
 - c. Frequency (Hz).
 - d. Real power (kW): For each phase, 3-phase total.
 - e. Reactive power (kVAR): For each phase, 3-phase total.
 - f. Apparent power (kVA): For each phase, 3-phase total.
 - g. Power factor.
 - h. Real energy (kWh).
 - i. Reactive energy (kVARh).
 - j. Apparent energy (kVAh).
 - k. Current demand.
 3. Meter Accuracy: Plus/minus 1.0 percent.
 4. Features:
 - a. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
 - b. KYZ pulse output.
 - c. Adjustable demand interval.
 - d. Remote monitoring capability via PC.
- N. Instrument Transformers:
 1. Comply with IEEE C57.13.
 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 3. Current Transformers: Connect secondaries to shorting terminal blocks.
 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Circuit Breakers:
 1. Interrupting Capacity:

- a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
- b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- 2. Molded Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
 - 2) Provide electronic trip circuit breakers where indicated.
 - b. Minimum Interrupting Capacity:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.
 - (c) Short time pickup and delay.
 - (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated.
 - e. Provide the following circuit breaker types where indicated:
 - 1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
 - f. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - 2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
- 3. Insulated Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
 - b. Operation:
 - 1) Provide manually operated circuit breakers unless otherwise indicated.
 - 2) Provide electrically operated circuit breakers where indicated.
 - c. Construction:
 - 1) Provide fixed-mount circuit breakers unless otherwise indicated.
 - d. Minimum Interrupting Capacity:
 - 1) 42,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 65,000 rms symmetrical amperes at 480 VAC.
 - e. Trip Units: Solid state, microprocessor-based, true rms sensing.
 - 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.

- (c) Short time pickup and delay.
 - (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated.
- 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
- 3) Provide communication capability where indicated: Compatible with system indicated.
- f. Provide the following circuit breaker types where indicated:
 - 1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
- g. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install switchboards plumb and level.
- G. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.
- H. Provide grounding and bonding in accordance with Section 260526.
- I. Install all field-installed devices, components, and accessories.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 260573.
- L. Provide filler plates to cover unused spaces in switchboards.

3.02 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.1.
- E. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.

- F. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- G. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- H. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- I. Test shunt trips to verify proper operation.
- J. Correct deficiencies and replace damaged or defective switchboards or associated components.
- K. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.03 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

3.04 CLEANING

- A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION

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**SECTION 262416
PANELBOARDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.
- E. Section 262813 - Fuses: Fuses for fusible switches and spare fuse cabinets.
- F. Section 264300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 67 - Panelboards; Current Edition, Including All Revisions.
- K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- L. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- M. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 4. Include documentation of listed series ratings upon request.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE
- B. Eaton Corporation.
- C. Schneider Electric; Square D Products.
- D. Siemens Industry, Inc.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
3. Label equipment utilizing series ratings as required by NFPA 70.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
- K. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- L. Provide the following features and accessories where indicated or where required to complete installation:
 1. Feed-through lugs.
 2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Copper.
 - 2. Ground Bus Material: Copper.
- D. Circuit Breakers:
 - 1. Provide bolt-on type.
 - 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
 - 3. Provide electronic trip circuit breakers where indicated.
- E. Enclosures:
 - 1. Provide surface-mounted enclosures unless otherwise indicated.
 - 2. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Phase and Neutral Bus Material: Copper.
 - 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 - 2. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
 - 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Copper, suitable for terminating copper conductors only.

4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - a. Provide the following field-adjustable trip response settings:
 - 1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - 2) Long time delay.
 - 3) Short time pickup and delay.
 - 4) Instantaneous pickup.
 - 5) Ground fault pickup and delay where ground fault protection is indicated.
 - b. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
8. Do not use handle ties in lieu of multi-pole circuit breakers.
9. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
10. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 260526.
 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- K. Install all field-installed branch devices, components, and accessories.
- L. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

- M. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- N. Provide filler plates to cover unused spaces in panelboards.

END OF SECTION

**SECTION 262726
WIRING DEVICES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.
- E. Floor box service fittings.
- F. Poke-through assemblies.

1.02 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 260583 - Wiring Connections: Cords and plugs for equipment.
- F. Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interruptioners; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.

3. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
4. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 1. Wall Dimmers: Include derating information for ganged multiple devices.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Operation and Maintenance Data:
 1. Wall Dimmers: Include information on operation and setting of presets.
 2. GFCI Receptacles: Include information on status indicators.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- E. Provide GFCI protection for receptacles installed in kitchens.
- F. Provide GFCI protection for receptacles serving electric drinking fountains.
- G. Unless noted otherwise, do not use combination switch/receptacle devices.

2.02 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
- C. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.
- D. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.

2.03 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: ww
 - 2. Leviton Manufacturing Company, Inc.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc.
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.04 WALL DIMMERS

- A. Manufacturers:
 - 1. Leviton Manufacturing Company, Inc.
 - 2. Lutron Electronics Company, Inc.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc.
- B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- C. Control: Slide control type with separate on/off switch.

2.05 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated.
 - 2. Leviton Manufacturing Company, Inc.
 - 3. Lutron Electronics Company, Inc.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc.
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - 2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
 - 3. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
 - 4. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.

2.06 WALL PLATES

A. Manufacturers:

1. Hubbell Incorporated.
2. Leviton Manufacturing Company, Inc.
3. Lutron Electronics Company, Inc.
4. Pass & Seymour, a brand of Legrand North America, Inc.

B. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

E. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.07 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:

1. Hubbell Incorporated.
2. Thomas & Betts Corporation.
3. Wiremold, a brand of Legrand North America, Inc.

B. Description: Service fittings compatible with floor boxes provided under Section 260533.16 with components, adapters, and trims required for complete installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Wall Dimmers: 48 inches above finished floor.
 - c. Receptacles: 18 inches above finished floor or 6 inches above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
 - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

END OF SECTION

SECTION 262813 FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.02 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 262413 - Switchboards: Fusible switches.
- C. Section 262416 - Panelboards: Fusible switches.
- D. Section 262816.16 - Enclosed Switches: Fusible switches.

1.03 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.
- E. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.
- F. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
 - 1. Spare Fuse Cabinet: Include dimensions.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Fuses: One set(s) of three for each type and size installed.
 - 3. Fuse Pullers: One set(s) compatible with each type and size installed.
 - 4. Spare Fuse Cabinet Keys: Two.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation.
- B. Littelfuse, Inc.
- C. Mersen.

2.02 APPLICATIONS

- A. Service Entrance:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
 - 2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- B. Feeders:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
 - 2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- C. General Purpose Branch Circuits: Class RK1, time-delay.
- D. Individual Motor Branch Circuits: Class RK1, time-delay.
- E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.
- F. Primary Protection for Control Transformers: Class CC, time-delay.

2.03 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
- H. Class L Fuses: Comply with UL 248-10.
- I. Class CC Fuses: Comply with UL 248-4.

2.04 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
- B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet where indicated.

END OF SECTION

**SECTION 262816.16
ENCLOSED SWITCHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262813 - Fuses.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- H. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.
3. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE.
- B. Eaton Corporation.
- C. Schneider Electric; Square D Products.
- D. Siemens Industry, Inc.
- E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 1. Minimum Ratings:
 - a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
 - b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
- G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- J. Conductor Terminations: Suitable for use with the conductors to be installed.

- K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
- M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- N. Heavy Duty Switches:
 - 1. Comply with NEMA BS 31047.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
 - a. Provide means for locking handle in the ON position where indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

END OF SECTION

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**SECTION 262913
ENCLOSED CONTROLLERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:
 - 1. Magnetic motor starters.
 - 2. General purpose contactors.
 - 3. Manual motor starters.
- B. Overcurrent protective devices for motor controllers, including overload relays.
- C. Control accessories:
 - 1. Auxiliary contacts.
 - 2. Pilot devices.
 - 3. Control and timing relays.
 - 4. Control power transformers.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262813 - Fuses: Fuses for fusible switches.

1.03 REFERENCE STANDARDS

- A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
 - 3. Coordinate the work to provide controllers and associated wiring suitable for interface with control devices to be installed.
 - 4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
6. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of enclosed controllers and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB/GE.
- B. Eaton Corporation.
- C. Schneider Electric; Square D Products.
- D. Siemens Industry, Inc.

2.02 ENCLOSED CONTROLLERS

- A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.
- D. Service Conditions:
 1. Provide controllers and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude:

- 1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.
 - 2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.
 - b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
 2. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- E. Short Circuit Current Rating:
1. Provide controllers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.
- F. Conductor Terminations: Suitable for use with the conductors to be installed.
- G. Enclosures:
1. Comply with NEMA ICS 6.
 2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 - b. Outdoor Locations: Type 3R or Type 4.
 3. Finish: Manufacturer's standard unless otherwise indicated.
- H. Magnetic Motor Starters: Combination type unless otherwise indicated.
1. Combination Magnetic Motor Starters: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
 2. Noncombination Magnetic Motor Starters: NEMA ICS 2, Class A noncombination motor controllers with magnetic contactor(s) and overload relay(s).
 3. Configuration: Full-voltage non-reversing unless otherwise indicated.
 4. Minimum Starter Size: NEMA Size 0.
 5. Use of non-standard starter sizes smaller than specified standard NEMA sizes is not permitted.
 6. Disconnects: Circuit breaker or disconnect switch type as indicated.
 - a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
 - b. Disconnect Switches: Fusible type unless otherwise indicated.
 - c. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
 - d. Provide auxiliary interlock for disconnection of external control power sources where applicable.
 7. Overload Relays: Bimetallic thermal type unless otherwise indicated.
 8. Pilot Devices Required:
 - a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.
- I. Manual Motor Starters:
1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).
 2. Configuration: Non-reversing unless otherwise indicated.
 3. Fractional-Horsepower Manual Motor Starters:
 - a. Furnish with toggle operator.
 - b. Overload Relays: Bimetallic or melting alloy thermal type.
 - c. Provide means for locking operator in the OFF position.
 - d. Furnish Red ON indicating light where not within sight of equipment.
 4. Integral-Horsepower Manual Motor Starters:

- a. Furnish with toggle or pushbutton operator.
 - b. Overload Relays: Bimetallic or melting alloy thermal type.
 - c. Provide means for locking operator in the OFF position.
 - d. Furnish Red ON indicating light where not within sight of equipment.
 - e. Provide auxiliary contact where indicated; normally open (NO) or normally closed (NC) as indicated or as required.
- J. Motor-Starting Switches: Horsepower-rated switches without overload protection; toggle operator.

2.03 OVERCURRENT PROTECTIVE DEVICES

- A. Overload Relays:
- 1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
 - 2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
 - 3. Trip-free operation.
 - 4. Visible trip indication.
 - 5. Resettable.
 - a. Employ manual reset unless otherwise indicated.
 - b. Do not employ automatic reset with two-wire control.
 - 6. Bimetallic Thermal Overload Relays:
 - a. Interchangeable current elements/heaters.
 - b. Adjustable trip; plus/minus 10 percent of nominal, minimum.
 - c. Trip test function.
 - 7. Melting Alloy Thermal Overload Relays:
 - a. Interchangeable current elements/heaters.
- B. Fusible Disconnect Switches:
- 1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA BS 31047, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
 - 2. Fuse Clips: As required to accept indicated fuses.
 - 3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- C. Circuit Breakers:
- 1. Interrupting Capacity (not applicable to motor circuit protectors):
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - 2. Motor Circuit Protectors:
 - a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.
 - b. Provide field-adjustable magnetic instantaneous trip setting.

2.04 CONTROL ACCESSORIES

- A. Auxiliary Contacts:
 - 1. Comply with NEMA IA 10039.
 - 2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each magnetic motor starter, minimum.
- B. Pilot Devices:
 - 1. Comply with NEMA IA 10039; heavy-duty type.
 - 2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
 - 3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
 - 4. Indicating Lights: Push-to-test type unless otherwise indicated.
 - 5. Provide LED lamp source for indicating lights and illuminated devices.
- C. Control and Timing Relays:
 - 1. Comply with NEMA IA 10039.
 - 2. Provide number and type of relays indicated or required to perform necessary functions.
- D. Control Power Transformers:
 - 1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices.
 - 2. Include primary and secondary fuses.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install controllers in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install enclosed controllers plumb and level.
- F. Provide grounding and bonding in accordance with Section 260526.
- G. Install all field-installed devices, components, and accessories.
- H. Provide fuses complying with Section 262813 for fusible switches as indicated.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

END OF SECTION

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**SECTION 265100
INTERIOR LIGHTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Drivers.
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 260923 - Lighting Control Devices.
- E. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.
- F. Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.
- B. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
- E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices; 2020.
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2023.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- K. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.

2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- E. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturer warranty for LED luminaires, including drivers.
- C. Provide five year pro-rata warranty for batteries for emergency lighting units.
- D. Provide ten year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Manufacturers:
 1. Acuity Brands, Inc.
 2. Cooper Lighting, a division of Cooper Industries.
 3. Hubbell Lighting, Inc.

- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
 - 3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.
 - 4. Air-Handling Recessed Fluorescent Luminaires: Suitable for air supply/return, heat removal, or combination as indicated.
 - a. Luminaires for Air Supply/Return: Provide air control blades where indicated.
 - b. Luminaires for Heat Removal: Provide heat removal dampers where indicated.
- I. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- J. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.
- K. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

- A. Manufacturers:
 - 1. Acuity Brands, Inc.
 - 2. Cooper Lighting, a division of Cooper Industries.
 - 3. Hubbell Lighting, Inc.
- B. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- C. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Battery:
 - 1. Sealed maintenance-free lead calcium unless otherwise indicated.
 - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- E. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- F. Provide low-voltage disconnect to prevent battery damage from deep discharge.

G. Accessories:

1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
3. Provide compatible accessory wire guards where indicated.
4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 EXIT SIGNS

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
1. Number of Faces: Single- or double-face as indicated or as required for installed location.
 2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
1. Manufacturers:
 - a. Acuity Brands, Inc.
 - b. Cooper Lighting, a division of Cooper Industries.
 - c. Hubbell Lighting, Inc.
 2. Self-Powered Exit Signs:
 - a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 - b. Battery: Sealed, maintenance-free, nickel cadmium unless otherwise indicated.
 - c. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 - d. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.05 DRIVERS

- A. Manufacturers:
1. Alloy LED.
 2. General Electric Company/GE Lighting.
 3. Lutron Electronics Company, Inc.
 4. OSRAM Sylvania, Inc.
 5. Philips Lighting North America Corporation.
- B. Drivers - General Requirements:
1. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 2. Electronic Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- C. Dimmable LED Drivers:
1. Dimming Range: Continuous dimming from 100 percent to one percent relative light output unless dimming capability to lower level is indicated, without flicker.
 2. Control Compatibility: Fully compatible with the dimming controls to be installed.
 - a. Wall Dimmers: See Section 262726.
 - b. Daylighting Controls: See Section 260923.

2.06 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, factory finished to match luminaire or field-painted as directed.

- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
- I. Suspended Luminaires:
 - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 - 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Install accessories furnished with each luminaire.
- L. Bond products and metal accessories to branch circuit equipment grounding conductor.
- M. Emergency Lighting Units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- N. Exit Signs:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- O. Install lamps in each luminaire.

3.02 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.03 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Air-Handling Luminaires with Air Control Blades or Heat Removal Dampers: Adjust as indicated or as required for proper airflow as directed by Architect.
- D. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

END OF SECTION

**SECTION 265600
EXTERIOR LIGHTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Lamps.
- C. Poles and accessories.
- D. Luminaire accessories.

1.02 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260923 - Lighting Control Devices.
 - 1. Includes automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.
 - 2. Includes lighting contactors.
- D. Section 265100 - Interior Lighting.

1.03 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.
- C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- E. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).
- F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices; 2020.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 2. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Manufacturers:
 1. Acuity Brands, Inc.
 2. Cooper Lighting, a division of Cooper Industries.
 3. Hubbell Lighting, Inc.
 4. Philips Lighting North America Corporation.
 5. NexGen Lighting Solution.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, driver, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

- H. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- I. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 DRIVERS

- A. Manufacturers:
 - 1. General Electric Company/GE Lighting
 - 2. OSRAM Sylvania, Inc
 - 3. Philips Lighting North America Corporation.
- B. Drivers - General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 - 3. Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- C. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to one percent relative light output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.04 POLES

- A. Manufacturers:
 - 1. Acuity Brands, Inc.
 - 2. Cooper Lighting, a division of Cooper Industries.
 - 3. Hubbell Lighting, Inc.
 - 4. Philips Lighting North America Corporation.
- B. All Poles:
 - 1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
 - 2. Material: Steel, unless otherwise indicated.
 - 3. Shape: per light fixture schedule.
 - 4. Finish: Match luminaire finish, unless otherwise indicated.
 - 5. Mounting Height: per light fixture schedule.
 - 6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
- C. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
- H. Suspended Luminaires:
 - 1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
- I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- J. Pole-Mounted Luminaires:
 - 1. Maintain the following minimum clearances:
 - a. Comply with IEEE C2.
 - b. Comply with utility company requirements.
 - 2. Grounding:
 - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
 - 3. Install separate service conductors, size as indicated on drawings, from each luminaire down to handhole for connection to branch circuit conductors.
- K. Install accessories furnished with each luminaire.
- L. Bond products and metal accessories to branch circuit equipment grounding conductor.
- M. Install lamps in each luminaire.

END OF SECTION

**SECTION 284600
FIRE DETECTION AND ALARM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.
- C. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.
- D. Maintenance of fire alarm system under contract for specified warranty period.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping: Materials and methods for work to be performed by this installer.
- B. Section 083323 - Overhead Coiling Doors: Coiling fire doors to be released by fire alarm system.
- C. Section 087100 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.
- D. Section 211300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
- E. Section 233300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
- F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Proposal Documents: Submit the following with cost/time proposal:
 - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
 - 3. Certification by Contractor that the system design will comply with Contract Documents.
 - 4. Proposed maintenance contract.
- C. Drawings must be prepared using AutoCad release.
 - 1. Owner will provide floor plan drawings for Contractor's use; verify all dimensions on Owner-provided drawings.

- D. Evidence of designer qualifications.
- E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
 - 1. Copy (if any) of list of data required by authority having jurisdiction.
 - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 - 4. System zone boundaries and interfaces to fire safety systems.
 - 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
 - 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
 - 7. List of all devices on each signaling line circuit, with spare capacity indicated.
 - 8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 - 9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 - 10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
 - 11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
 - 12. Certification by Contractor that the system design complies with Contract Documents.
 - 13. Do not show existing components to be removed.
- F. Evidence of installer qualifications.
- G. Evidence of instructor qualifications; training lesson plan outline.
- H. Evidence of maintenance contractor qualifications, if different from installer.
- I. Inspection and Test Reports:
 - 1. Submit inspection and test plan prior to closeout demonstration.
 - 2. Submit documentation of satisfactory inspections and tests.
 - 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- J. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
 - 1. Original copy of NFPA 72 with portions that are not relevant to this project neatly crossed out by hand; label with project name and date.
 - 2. Complete set of specified design documents, as approved by authority having jurisdiction.
 - 3. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 - 4. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 - 5. List of recommended spare parts, tools, and instruments for testing.
 - 6. Replacement parts list with current prices, and source of supply.
 - 7. Detailed troubleshooting guide and large scale input/output matrix.
 - 8. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
 - 9. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

- K. Project Record Documents: See Section 017800 for additional requirements; have one set available during closeout demonstration:
 - 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 - 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 - 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- L. Closeout Documents:
 - 1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 - 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
 - 3. Certificate of Occupancy.
 - 4. Maintenance contract.
 - 5. Report on training results.
- M. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
 - 1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 - 2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
 - 3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
- C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
- C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable fire alarm system: Notifier NFS2-3030 with voice notification. The proposed alternate systems to be pre-approved by Dallas ISD designated representative, and Dallas ISD-Maintenance and Operations (M&O).
- B. Fire alarms system to have integral mass notification.
- C. Acceptable Fire Alarm Control Units and Accessories:
 - 1. Provide control units made by the same manufacturer.
- D. Initiating Devices and Notification Appliances:
 - 1. Same manufacturer as control units.
 - 2. Provide initiating devices and notification appliances made by the same manufacturer, where possible.
- E. Substitutions: See Section 016000 - Product Requirements.
 - 1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with Contract Documents.
 - 2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.02 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
 - 1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
 - 2. Protected Premises: entire building.
 - 3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards.
 - b. The requirements of the State Fire Marshal.
 - c. The requirements of the local authority having jurisdiction.
 - d. Applicable local codes.
 - e. Contract Documents (drawings and specifications).
 - f. NFPA 101.
 - g. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
 - h. Dallas ISD Latest Technical Design Guidelines.
 - 4. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.
 - 5. The system shall be support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.

6. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
 7. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
 8. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
 9. Program notification zones and voice messages as directed by Owner.
 10. Hearing Impaired Occupants: Provide visible notification devices in all public areas.
 11. Fire Command Center: Located in on-premises supervising station.
 12. Master Fire Alarm Control Unit: New, located per drawing.
 13. Two-Way Telephone: Provide two-way telephone service for the use of the fire service and others; provide jacks and two portable handsets.
 14. Combined Systems: Do not combine fire alarm system with other non-fire systems.
- B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By on-premises supervising station.
 2. Remote Supervising Station: UL-listed central station under contract to facility.
 3. Fire alarm system is monitored by an AES-Multinet receiver at Dallas ISD's central monitoring system. Fire alarm systems are to report to central monitoring system via AES 7707P-88-ULP-M device or Dallas ISD approved equal. If the central monitoring system is not available, signal is to be sent to Southwest Dispatch or as directed by Dallas ISD designated representative. Provide twelve months of monitoring service required as part of the installation.
 4. Auxiliary Connection Type: Local energy.
- C. Circuits:
1. Initiating Device Circuits (IDC): Class A, style D.
 2. Signaling Line Circuits (SLC) Within Single Building: Class A, style 6.
 3. Signaling Line Circuits (SLC) Between Buildings: Class A, style 6.
 4. Notification Appliance Circuits (NAC): Class B, style Y.
 5. Provide a minimum of 6-foot separation (vertical and horizontal) between supply and return loops in all Class "A" wired circuits.
 6. City of Dallas requires Class "A" wiring to all initiating devices except addressable devices used to monitor the status of a suppression system.
- D. Spare Capacity:
1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 3. Speaker Amplifiers: Minimum 25 percent spare capacity.
 4. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- E. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
 2. Secondary: Storage batteries.
 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
 4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 EXISTING COMPONENTS

- A. Existing Fire Alarm System: Remove existing components indicated on fire alarm shop drawings and incorporate remaining components into new system, under warranty as if they were new; do not take existing portions of system out of service until new portions are fully operational, tested, and connected to existing system.

- B. Clearly label components that are "Not In Service."
- C. Remove unused existing components and materials from site and dispose of properly.

2.04 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 - 1. Sprinkler water control valves.
 - 2. Dry-pipe sprinkler system pressure.
 - 3. Dry-pipe sprinkler valve room low temperature.
 - 4. Elevator shut-down control circuits.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
 - 1. Sprinkler water flow.
 - 2. Kitchen hood suppression activation; also disconnect fuel source from cooking equipment.
 - 3. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
 - 4. Duct smoke detectors.
- C. Elevators:
 - 1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
 - 2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
 - 3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.
- D. HVAC:
 - 1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
- E. Doors:
 - 1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 087100.
 - 2. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from. Refer to Section 087100.
 - 3. Overhead Coiling Fire Doors: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 083323.

2.05 COMPONENTS

- A. General:
 - 1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 - 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units (FACP): Analog, addressable type Notifier NFS2 - 3030 - intelligent Fire Alarm Control Panel with integrated voice notification. Main fire alarm control unit shall contain a microprocessor based Central Processing Unit (CPU) and power supply. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.
- C. The main FACP shall perform the following functions:
 - 1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
 3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.
- D. The FACP shall be capable of expansion via up to 10 SLC loops. Each module shall support up to 318 analog/addressable devices for a maximum system capacity of 3180 points. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a QWERTY style alphanumeric keypad for the field programming and control of the fire alarm system.
- E. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels/nodes per network.
- F. Digital Voice Command Center
1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.
 2. Function: The Voice Command Center equipment shall perform the following functions:
 - a. Operate as a supervised multi-channel emergency voice communication system. Operate as a two-way emergency telephone system control center.
 - b. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
 - c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
 - d. Provide all-call Emergency Paging activities through activation of a single control switch.
 - e. As required, provide vectored paging control to specific audio zones via dedicated control switches.
 - f. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows operating system.
 - g. Provide a software utility capable of off-line programming for the DVC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the DVC shall not inhibit the emergency operation of other nodes on the fire alarm network.
 - h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SLC controlled switching.
 - i. The Digital Voice Command shall be modular in construction and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
 - j. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.
- G. Remote Annunciator panel: From same manufacturer as main control panel.

1. Flush cabinet, NEMA 250, Type 1, annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 2. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
- H. Audio Amplifiers
1. The Audio Amplifiers will provide Audio Power for distribution to speaker circuits.
 2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
 3. The audio amplifier shall include an integral power supply, and built-in LED indicators and controls.
 4. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
 5. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
 6. System shall be capable of backing up digital amplifiers.
 7. System shall be capable of backing up digital amplifiers.
 8. One-to-one backup shall be provided by either a plug-in amplifier card or a designated backup amplifier of identical model as the primary amplifier.
 9. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
 10. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.
- I. Audio Message Generator (Prerecorded Voice)/Speaker Control:
1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
 2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
 3. A built-in microphone shall be provided to allow paging through speaker circuits.
 4. System paging from emergency telephone circuits shall be supported.
 5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:
 - a. Lamp Test
 - b. Trouble
 - c. Off-Line Trouble
 - d. Microphone Trouble
 - e. Phone Trouble
 - f. Busy/Wait
 - g. Page Inhibited
 - h. Pre/Post Announcement Tone
- J. Initiating Devices:
1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
- K. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.
- L. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

1. Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral, and 350 V(ac), line-to-line; do not use fuses.
 2. Initiating Device Circuits, Notification Appliance Circuits, and Communications Circuits: Provide surge protection at each point where circuit exits or enters a building; rated to protect applicable equipment; for 24 V(dc) maximum dc clamping voltage of 36 V(dc), line-to-ground, and 72 V(dc), line-to-line.
 3. Signaling Line Circuits: Provide surge protection at each point where circuit exits or enters a building, rated to protect applicable equipment.
- M. In addition to any built-in surge protection of the fire alarm panel, each fire alarm panel and power supply panel shall have an added surge protector installed. The secondary surge protection device must be installed in a manner that it is isolated a minimum of two feet from the panel as measured along the route of electrical travel. If data lines run between separate buildings, data line surge/spike protection is required on each data line where the line enters and/or exits each building (Refer to NFPA 72 section 12.2.4.2 and NFPA 4.10.7.7.1).
- N. Fire Alarm systems used for partial evacuation and relocation shall be designed and installed such that attack by fire within an evacuation signaling zone shall not impair control and operation of the notification appliances outside the evacuation signaling zone per section 23.10 of NFPA-72. Signaling line circuits used to control notification appliances in multiple evacuation signaling zones should be properly designed and installed so that one fire would not impair the signaling line circuit, rendering the notification appliances serving more than one evacuation signaling zone inoperative. Cabling is located inside the 2-hour rated electrical rooms and the risers inside the parking garage are in the DAS conduit in the rated concrete wall.
- O. The secondary power supply for the in-building fire emergency voice/alarm communication service shall be capable of operating the system under quiescent load for a minimum of 24-hours and then be capable of operating system during fire or other emergency condition for a period of 15 minutes at maximum connected load per NFPA-72 section 10.6.7.2.1.
- P. Locks and Keys: Deliver keys to Owner.
1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 5 keys of each type
- Q. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
 2. Provide one for each control unit where operations are to be performed.
 3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
 4. Provide extra copy with operation and maintenance data submittal.
- R. Attic stock: Upon completion of fire alarm system installation, provide 10% of field devices, one SLC (signaling line circuit) Loop Card, one CPU (central processing unit), one ACM-24AT annunciator control module, if used, and one remote power supply.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.
- B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- C. Obtain Owner's approval of locations of devices before installation.
- D. Install instruction cards and labels.
- E. Main fire alarm control panel shall be located in the main administrative office.
- F. All fire alarm AC breakers to have lock-on devices installed per NEC.

- G. All fire alarm devices mounted to a suspended ceiling shall be securely fastened in place in accordance with NFPA 70, section 314.23. All fire alarm wiring and associated equipment must be installed in a neat and workmanlike manner.
- H. Integrity of single or multiple circuits providing interface between two or more control panels shall be verified. Interfaced equipment connections shall be tested by operating or simulating operation of the equipment being supervised. Signals required to be transmitted shall be verified at control panel per table 14.4.2.2 (22) of NFPA 72 2013 editions.
- I. The FACP general, supervisory, and trouble alarms must be annunciated to a constantly occupied area of the building or the system must be monitored in accordance with section 907.6.5 of the International Fire Code-2015 edition.
- J. A smoke detector must be provided at all fire alarm control units that are located in areas that are not continuously occupied per NFPA 72-2013 edition, section 10.15.

3.02 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
- G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- H. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
 - 1. Record all system operations and malfunctions.
 - 2. If a malfunction occurs, start diagnostic period over after correction of malfunction.
 - 3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
 - 4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.03 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
 - 3. Factory Instruction: At control unit manufacturer's training facility.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
 - 1. Initial Training: 1 session pre-closeout.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.

- D. Detailed Operation: Two-hour sessions for engineering staff; assume NICET level I qualifications or equivalent; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.
- E. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
 - 1. Initial Training: One 3-day session, pre-closeout.
- F. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.
- G. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.

3.04 CLOSEOUT

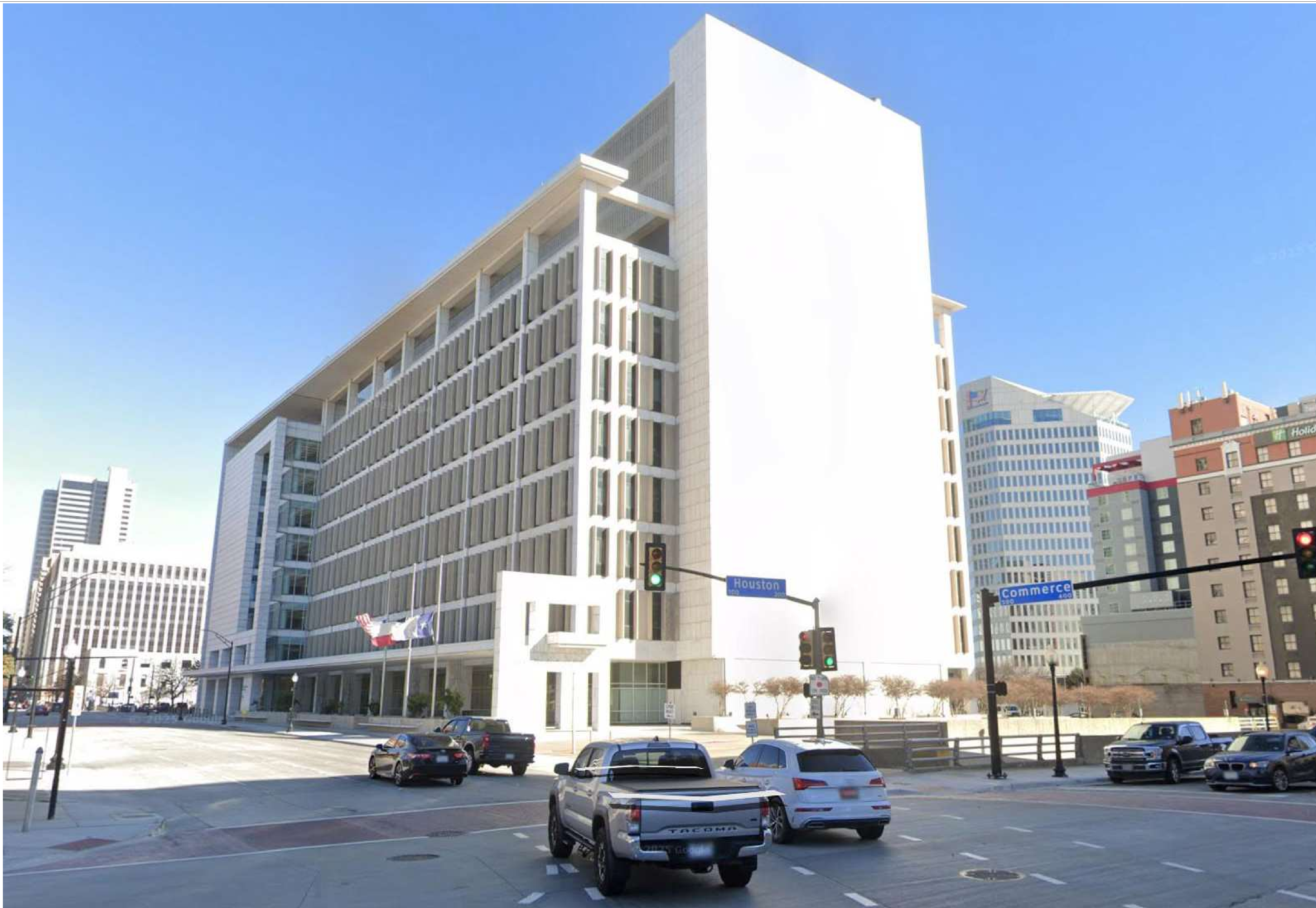
- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
 - 1. Be prepared to conduct any of the required tests.
 - 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 - 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 - 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 - 5. Repeat demonstration until successful.
- B. Occupancy of the project will not occur prior to Substantial Completion.
- C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
 - 1. Specified diagnostic period without malfunction has been completed.
 - 2. Approved operating and maintenance data has been delivered.
 - 3. Spare parts, extra materials, and tools have been delivered.
 - 4. All aspects of operation have been demonstrated to Owner.
 - 5. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 - 6. Occupancy permit has been granted.
 - 7. Specified pre-closeout instruction is complete.

3.05 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.
- C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
 - 1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 - 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
 - 3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Provide on-site response within 2 hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

- E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- G. Comply with Owner's requirements for access to facility and security.

END OF SECTION



RENDERING FOR ARTISTIC REPRESENTATION ONLY

DALLAS COUNTY GEORGE ALLEN COURTHOUSE HVAC REPLACEMENT

ISSUE FOR BID

09/26/2025

Kirksey
ARCHITECTURE

Dallas + Houston + Austin

143 Manufacturing Street

Dallas Texas 75207

214 522 1100

kirksey.com

PROJECT TEAM

OWNER
DALLAS COUNTY
133 N. RIVERFRONT BLVD., SUITE 9A600
DALLAS, TX 75207
214-653-6776

STRUCTURAL ENGINEER
CLICK ENGINEERING
2218 Bryan St Ste 150
Dallas, TX 75201
214-871-2302

MEP ENGINEER
CAMPOS ENGINEERING
1331 River Bend Dr
Dallas, TX 75247-4962
214-696-6291

ARCHITECT
KIRKSEY ARCHITECTURE
143 Manufacturing St
Dallas, TX 75207
214-522-1100



26 SEPTEMBER 2025

PROJECT NAME
DALLAS COUNTY GEORGE
ALLEN COURTHOUSE HVAC
REPLACEMENT

PROJECT ADDRESS
600 COMMERCE ST.
DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

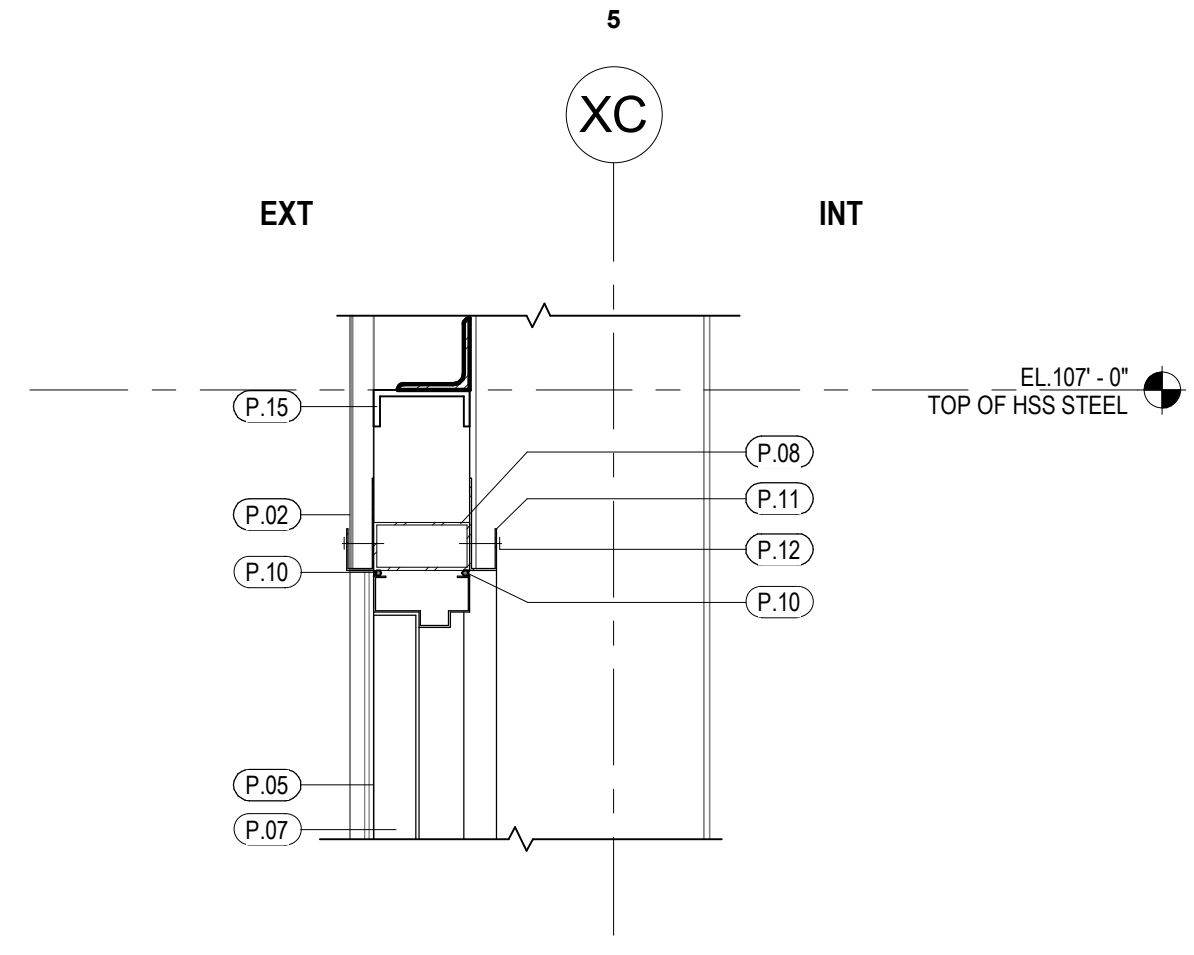
NOT FOR REGULATORY APPROVAL,
PERMITTING, OR CONSTRUCTION
CHRISTEL JOY HAUGHT 05/23/2025

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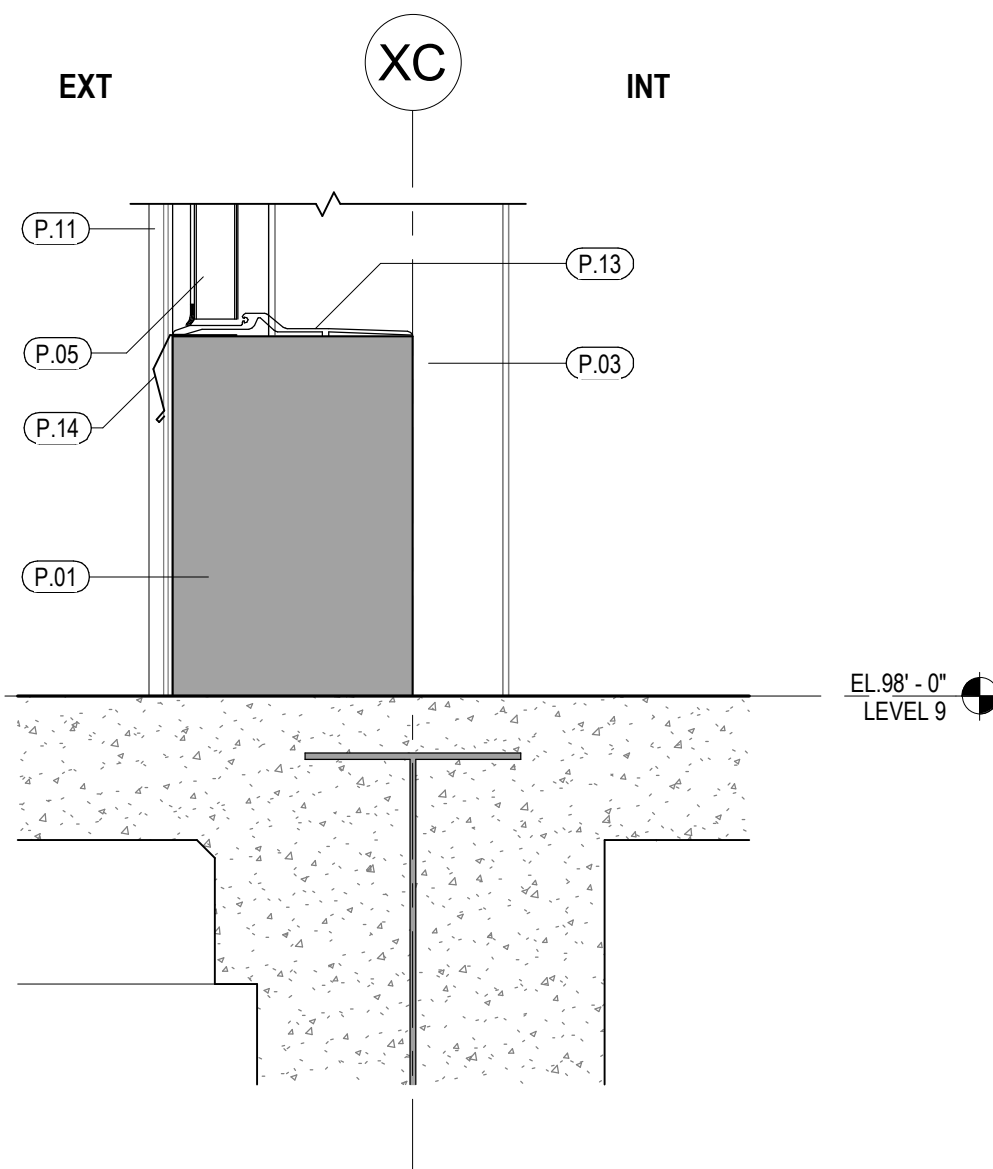


SHEET NOTES

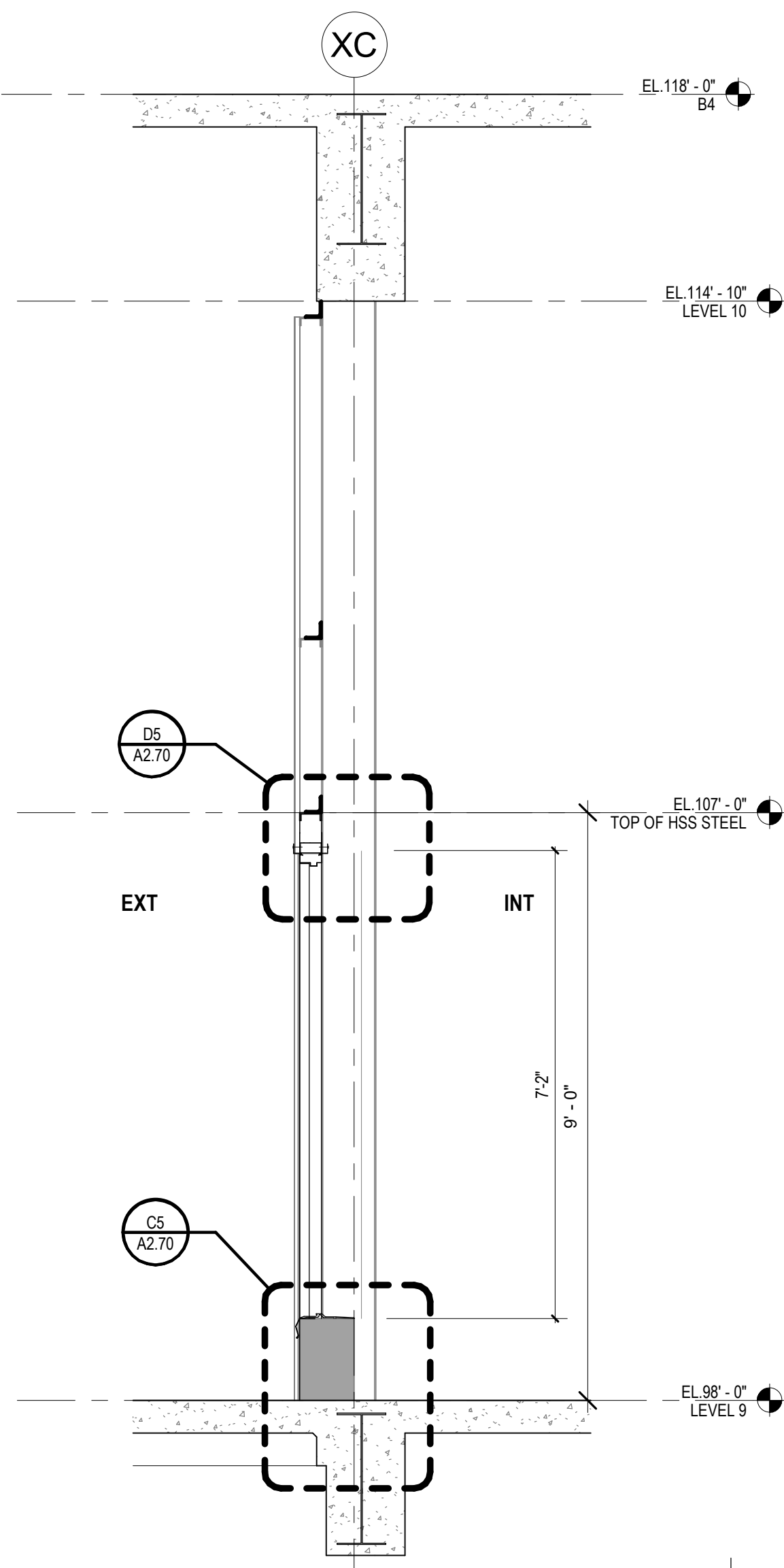
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	HINGE	58B1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080T 06A	630	SCH
1	EA	FSIC CORE	23-030 (MATCH FACILITY KEYWAY)	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS X MTG	689	LCN
1	EA	RAIN DRIP	142A DW + 4"		ZER
1	SET	GASKETING	REPLACE AS REQ 328AA H & J	AA	ZER
1	EA	THRESHOLD SEAL	REPLACE AS REQ 475AA LENGTH AS REQ	AA	ZER
1	EA	DOOR SWEEP	REPLACE AS REQ 8198AA LENGTH AS REQ	AA	ZER
2	EA	ROOF CURB THRESHOLD	REPLACE AS REQ 105-NH LENGTH AS REQ	A	ZER
1	EA	ADJUSTABLE SADDLE	ANCHORS AS REQ 672NH - 6710NH WIDTH AND LENGTH AS REQ FASTENERS AS REQUIRED	A	ZER



ACCESS HATCH HEAD DETAIL	D5



ACCESS HATCH SECTION DETAIL	C5



WALL SECTION	B5

SHEET NOTES

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01-DESIGN CRITERIA

1. THIS PROJECT SHALL MEET ALL REQUIREMENTS OF THE 2015 INTERNATIONAL BUILDING CODE AND THE CITY OF DALLAS, TX

2. DESIGN LIVE LOADS:

ROOF

FLOOR LOAD

TYPICAL UNO.

MECHANICAL AREAS

LIGHT STORAGE

HEAVY STORAGE

OFFICE

20 PSF

100 PSF

150 PSF

125 PSF

250 PSF

50 PSF

LIVE LOADS HAVE BEEN REDUCED WHERE ALLOWED BY CODE

3. DESIGN WIND LOADS

RISK CATEGORY: II

ULT DESIGN WIND SPEED (3 SEC GUST) VULT: 105 MPH

WIND EXPOSURE: C

APPLICABLE INTERNAL COEFFICIENT (Gcpi): +/- 0.18

02-GENERAL

1. SHOP DRAWINGS: ONE (1) PRINT AND A PDF FILE OF EACH DRAWING ARE TO BE SUBMITTED TO THE STRUCTURAL ENGINEER FOR REVIEW. DISTRIBUTION OF PRINTS IS TO BE MADE ONLY FROM PRINTS BEARING A SIGNED REVIEW STAMP. NO WORK ON ITEMS SHOWN THEREON IS TO PROCEED UNLESS THE STAMP CLEARLY INDICATES "NO EXCEPTIONS TAKEN" OR "MAKE CORRECTIONS NOTED". GENERAL CONTRACTOR SHALL PRE-CHECK ALL SHOP DRAWINGS BEFORE SUBMISSION TO ENGINEER FOR REVIEW. THE CONTRACTOR SHALL ALLOW THE ENGINEER TWO WEEKS FOR REVIEWING THE SHOP DRAWINGS. REFER "SUBMITTALS" SECTION OF GENERAL NOTES FOR ADDITIONAL INFORMATION.

2. STRUCTURAL DRAWINGS MAY NOT BE USED AS SHOP DRAWINGS.

3. VERIFY THE SIZE AND LOCATION OF ALL MECHANICAL AND ELECTRICAL OPENINGS, AND VERIFY NO CONFLICT WITH STRUCTURAL ELEMENTS. CONSULT STRUCTURAL ENGINEER IF LOCATIONS OR WEIGHTS OF ROOF TOP UNITS OR OTHER MECHANICAL EQUIPMENT DIFFER FROM THOSE SHOWN ON PLAN.

4. PROVIDE ALL CONCRETE PADS, TRAPS, BASINS, ETC., SHOWN ON MECHANICAL DRAWINGS WHERE INDICATED TO BE SUPPLIED BY GENERAL CONTRACTOR.

5. VERIFY ALL DIMENSIONS SHOWN ON THE STRUCTURAL DRAWINGS WITH THE ARCHITECTURAL AND STRUCTURAL DRAWINGS AND EXISTING CONDITIONS. CONTRACTOR IS TO NOTIFY ARCHITECT AND OBTAIN CLARIFICATION IN WRITING PRIOR TO PROCEEDING.

6. STACKS OF MATERIALS OR OTHER CONSTRUCTION LOADS PLACED ON THE STRUCTURE SHALL NOT EXCEED THE STATED DESIGN LIVE LOAD FOR THE AREA AFFECTED UNLESS ADEQUATELY SHORED.

7. WHERE DIMENSIONS ARE PROVIDED FOR OPENINGS, BLOCK OUTS, FLOOR DEPRESSIONS, CURBS, ETC., BUT MAY BE AFFECTED BY THE EQUIPMENT PURCHASED, THE CONTRACTOR SHALL VERIFY THE INFORMATION PROVIDED PRIOR TO CONSTRUCTION.

8. FLOOR FLATNESS/LEVELNESS SHALL MEET ARCHITECTURAL SPECIFICATIONS (1/2" IN 10 FOOT MINIMUM LEVELNESS UNLESS TIGHTER REQUIREMENTS IN SPECIFICATIONS.) IN HEIGHT FOR ALL STRUCTURAL SYSTEMS. CONTRACTOR SHALL INCLUDE COST FOR LEVELING ALL FLOORS. FOR ESTIMATING PURPOSES ONLY, ASSUME 1/2" THICK LEVELING AGENT OVER 15% IF FLOOR AREA.

9. SEQUENCING CONSTRUCTION AND LATERAL STABILITY:

THE STRUCTURAL COMPONENTS BY THEMSELVES ARE A NON-SELF-SUPPORTING STRUCTURE. LATERAL FORCES DUE TO WIND, EARTHQUAKE, OR SOIL ARE CARRIED BY THE ROOF AND FLOOR DIAPHRAGMS TO THE LATERAL SYSTEM. CERTAIN ELEMENTS SHOWN ON OR LOCAL STABILITY OF OTHER ELEMENTS (SUCH AS BEAMS, COLUMNS, AND WALLS). IF DUE TO SEQUENCING OF CONSTRUCTION, THESE STABILITY ELEMENTS ARE NOT IN PLACE, THE CONTRACTOR SHALL RETAIN A LICENSED STRUCTURAL ENGINEER WHO SHALL INVESTIGATE WHERE TEMPORARY SHORING/BRACING IS REQUIRED, AND SHALL DESIGN THIS TEMPORARY SHORING/BRACING. THE CONTRACTOR SHALL PROVIDE THIS SHORING/BRACING UNTIL THE DESIRED STRUCTURAL ELEMENTS AND THEIR CONNECTIONS HAVE BEEN INSTALLED AND REACH THEIR FINAL DESIGN STRENGTHS.

03-CONCRETE

1. ALL CONCRETE AND METAL REINFORCEMENT SHALL BE FABRICATED AND PLACED IN CONFORMITY WITH THE "ACI STANDARD BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE" (ACI 318-10)

2. POURED IN PLACE CONCRETE SHALL STRICTLY ADHERE TO THE PROPORTIONS, ESTABLISHED IN DESIGN MIXES, CONSISTING OF THE ACTUAL MATERIALS TO BE USED DURING CONSTRUCTION, FOR THE SEVERAL STRENGTHS AND USES INTENDED. THESE DESIGN MIXES ARE TO BE PREPARED BY A PRE-QUALIFIED LABORATORY, AND THE MATERIALS AND TEST RESULTS ARE TO BE REVIEWED BY THE ENGINEER AND OWNER'S LAB REPRESENTATIVE PRIOR TO USE.

3. POURED IN PLACE CONCRETE IS TO BE NORMAL WEIGHT AND IS TO DEVELOP COMPRESSIVE STRENGTH FC AT 28 DAYS PER CLASS OF CONCRETE SCHEDULE.

4. UNLESS OTHERWISE NOTED, METAL REINFORCEMENT FOR POURED IN PLACE CONCRETE IS TO BE ASTM A-615, GRADE 60. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A-185. (GRADE 15 FOR COLUMN BARS 1" AND LARGER)

5. VERIFY THE PRESENCE, LOCATION, SIZES AND CORRECTNESS OF ALL OPENINGS, SLAB DEPRESSIONS AND EMBEDMENTS REQUIRED PRIOR TO CONCRETING. NO OPENINGS SHALL BE PERMITTED THROUGH BEAMS OR COLUMNS UNLESS SHOWN ON THE STRUCTURAL DRAWINGS OR REVIEWED BY THE STRUCTURAL ENGINEER.

6. PROPER ACCESSORIES/SUPPORTS ARE TO BE USED AS NOTED AND REVIEWED ON THE SHOP DRAWINGS. ALL REINFORCING TO BE SECURELY AND ACCURATELY HELD IN LOCATIONS SHOWN ON THE PLANS.

7. CONSTRUCTION JOINTS OF ALL TYPES MAY BE USED ONLY WHERE SHOWN ON THE FABRICATOR'S REVIEWED PLACING DRAWINGS.

8. PROVIDE CORNER BARS IN ALL GRADE BEAMS AND WALLS OF SAME SIZE AND SPACING AS ADJACENT BARS, UNLESS OTHERWISE NOTED.

9. PROVIDE STANDARD 90 DEGREE HOOKS ON ALL BARS AT BEAM ENDS. IF BEAM DEPTH IS PROHIBITIVE, USE STANDARD 180 DEGREE HOOK.

10. BARS SCHEDULED AS CONTINUOUS SHALL BE SPLICED WITH A 'CLASS B LAP' AND SPLICED AS FOLLOWS: TOP BARS AT CENTERLINE OF ANY SPAN. BOTTOM BARS OVER ANY SUPPORT.

11. UNLESS OTHERWISE SHOWN, ALL SLABS AND STEPS ON RILL SHALL BE REINFORCED WITH #4 BARS AT 18" CENTERS EACH WAY, SUPPORTED TWO INCHES FROM THE TOP OF SLAB, LAP 22" AT SPLICES.

12. POUR SLABS ON GRADE IN SECTIONS NOT TO EXCEED 225 SF SEPARATED BY KEYS OR DOUBLED CONSTRUCTION CONTROL JOINTS OR SAUED JOINTS. NO DIMENSION IN EITHER DIRECTION IS TO EXCEED 15'-0".

13. MINIMUM CONCRETE COVER PROTECTION FOR REINFORCEMENT BARS SHALL BE AS FOLLOWS: (REFERENCE ACI 318 SECTION 1.1 FOR ADDITIONAL INFORMATION)

UNLESS NOTED OTHERWISE

MINIMUM COVER, INCHES, TO NEAREST BAR, TIE OR STIRRUP

CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH

CONCRETE EXPOSED TO EARTH OR WEATHER:

#6 THROUGH #18 BARS

#5 BAR AND SMALLER

CONCRETE NOT EXPOSED TO WEATHER OR IN CONTACT WITH GROUND:

SLABS, WALLS

#14 AND #18 BARS

#11 BARS AND SMALLER

BEAMS, COLUMNS:

PRIMARY REINFORCEMENT, TIES, STIRRUPS, ... 1 1/2"

04-MISCELLANEOUS

1. CONTRACT DOCUMENTS

A. IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO OBTAIN ALL CONTRACT DOCUMENTS AND LATEST APPENDS AND TO SUBMIT SUCH DOCUMENTS TO ALL SUBCONTRACTORS AND MATERIAL SUPPLIERS PRIOR TO THE SUBMITTAL OF SHOP DRAWINGS, FABRICATION OF ANY STRUCTURAL MEMBERS, AND ERECTION IN THE FIELD.

B. THE CONTRACT STRUCTURAL DRAWINGS AND SPECIFICATIONS REPRESENT THE FINISHED STRUCTURE AND, EXCEPT WHERE SPECIFICALLY SHOWN, DO NOT INDICATE THE METHOD OR MEANS OF CONSTRUCTION. THE CONTRACTOR SHALL SUPERVISE AND DIRECT THE WORK AND SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, PROCEDURES, TECHNIQUES, AND SEQUENCE.

2. DRAWING CONFLICTS

THE GENERAL CONTRACTOR SHALL COMPARE THE ARCHITECTURAL AND STRUCTURAL DRAWINGS AND REPORT ANY DISCREPANCY BETWEEN EACH SET OF DRAWINGS AND WITHIN EACH SET OF DRAWINGS TO THE ARCHITECT AND ENGINEER PRIOR TO THE FABRICATION AND INSTALLATION OF ANY STRUCTURAL MEMBERS.

3. EXISTING CONDITIONS

THE GENERAL CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CONDITIONS OF THE EXISTING BUILDING AT THE JOB SITE AND REPORT ANY DISCREPANCIES FROM ASSUMED CONDITIONS SHOWN ON THE DRAWINGS TO THE ARCHITECT AND ENGINEER PRIOR TO THE FABRICATION AND ERECTION OF ANY MEMBERS.

4. RESPONSIBILITIES OF THE CONTRACTOR FOR STABILITY OF THE STRUCTURE DURING CONSTRUCTION

ALL STRUCTURAL ELEMENTS OF THE PROJECT HAVE BEEN DESIGNED BY THE STRUCTURAL ENGINEER TO RESIST THE REQUIRED CODE VERTICAL AND LATERAL FORCES THAT COULD OCCUR IN THE FINAL COMPLETED STRUCTURE ONLY. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE ALL REQUIRED BRACING DURING CONSTRUCTION TO MAINTAIN THE STABILITY AND SAFETY OF ALL STRUCTURAL ELEMENTS DURING THE CONSTRUCTION PROCESS UNTIL THE LATERAL-LOAD RESISTING OR STABILITY-PROVIDING SYSTEM IS COMPLETELY INSTALLED AND THE STRUCTURE IS COMPLETELY TIED TOGETHER.

5. CONFLICTS IN STRUCTURAL REQUIREMENTS

WHERE CONFLICT EXISTS AMONG THE VARIOUS PARTS OF THE STRUCTURAL CONTRACT DOCUMENTS, STRUCTURAL DRAWINGS, GENERAL NOTES, AND SPECIFICATIONS, THE STRICTEST REQUIREMENTS, AS INDICATED BY THE ENGINEER, SHALL GOVERN.

6. THE STRUCTURAL ENGINEER'S ROLE DURING CONSTRUCTION

THE ENGINEER SHALL NOT HAVE CONTROL, NOR CHARGE OF, AND SHALL NOT BE RESPONSIBLE FOR, THE CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES OR PROCEDURES, FOR SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK OR THE ACTS OR OMISSIONS OF THE CONTRACTOR, SUBCONTRACTOR, OR ANY OTHER PERSONS PERFORMING ANY OF THE WORK, OR THE FAILURE OF ANY OF THEM TO CARRY OUT THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

7. PERIODIC SITE OBSERVATION BY FIELD REPRESENTATIVES OF CLICK ENGINEERING IS SOLELY FOR THE PURPOSES OF BECOMING GENERALLY FAMILIAR WITH THE PROGRESS AND QUALITY OF THE WORK COMPLETED AND DETERMINING, IN GENERAL, IF THE TASK OBSERVATION IS BEING PERFORMED IN A MANNER INDICATING THAT THE WORK, WHEN FULLY COMPLETED, WILL BE IN ACCORDANCE WITH THE STRUCTURAL CONTRACT DOCUMENTS. THIS LIMITED SITE OBSERVATION SHOULD NOT BE CONSTRUED AS EXHAUSTIVE OR CONTINUOUS TO CHECK THE QUALITY OR QUANTITY OF THE WORK, BUT RATHER PERIODIC IN AN EFFORT TO GUARD THE OWNER AGAINST DEFECTS OR DEFICIENCIES IN THE WORK OF THE CONTRACTOR.

ENGINEER OF RECORD SHALL PROVIDE VISUAL OBSERVATION OF THE STRUCTURAL SYSTEM FOR GENERAL CONFORMANCE TO THE APPROVED PLANS AND SPECIFICATIONS. AT SIGNIFICANT CONSTRUCTION STAGES AND AT THE COMPLETION OF THE STRUCTURAL SYSTEM, CONTRACTOR IS REQUIRED FOR COORDINATING THE TIMING OF SITE VISITS AND SHALL INCLUDE A MINIMUM IF 3 VISITS. THESE VISITS ARE TO BE PAID FOR BY THE CONTRACTOR. STRUCTURAL OBSERVATION DOES NOT INCLUDE OR WAIVE THE RESPONSIBILITY FOR THE INSPECTIONS REQUIRED BY THE BUILDING CODE NOTED.

05-SUBMITTALS

1. SUBMITTAL LIST AND SCHEDULE

THE GENERAL CONTRACTOR SHALL PREPARE A DETAILED LIST AND SCHEDULE OF ALL SUBMITTAL ITEMS TO BE SENT TO THE STRUCTURAL ENGINEER PRIOR TO THE START OF CONSTRUCTION. THIS LIST SHALL BE UPDATED AND REVISED AND KEPT CURRENT AS THE JOB PROGRESSES. THE SUBMITTAL LIST SHALL BE ORGANIZED AS SHOWN BELOW.

A. SHOP DRAWINGS

B. MANUFACTURERS LITERATURE FOR PRODUCTS, ASSEMBLIES, AND HARDWARE

C. PRODUCTS, ASSEMBLIES AND HARDWARE

D. PRODUCT CERTIFICATIONS, MILL CERTIFICATES, AND AFFIDAVITS

E. DESIGN CALCULATIONS

2. SHOP DRAWINGS

A. THE GENERAL CONTRACTOR SHALL SUBMIT FOR ENGINEER REVIEW SHOP DRAWINGS FOR THE FOLLOWING ITEMS:

1)CONCRETE MIX DESIGN (*)

2)EMBEDDED ITEMS (PLATES, ANGLES, BOLTS, ETC.) OR ITEMS ATTACHED TO THE STRUCTURAL FRAME FOR BUILDING CLADDING ATTACHMENT OR FOR ATTACHMENT OF OTHER ITEMS, (*)

3)LIGHT GAUGE METAL (COLD FORMED STEEL) (*) USED TO SUPPORT EXTERIOR CLADDING OR AS LOAD BEARING MEMBERS

4)MECHANICAL ELECTRICAL, PLUMBING OPENINGS IN FLAT SLABS

5)MISCELLANEOUS STEEL

6)REINFORCING STEEL

7)STRUCTURAL STEEL SHOP DRAWINGS (*)

8)STRUCTURAL STEEL ERECTION AND BRACING DRAWINGS (**)

NOTES:

(*) ITEMS MARKED THIS SHALL HAVE SHOP DRAWINGS SEALED BY A REGISTERED ENGINEER IN THE STATE WHERE THE PROJECT IS LOCATED PER THE PROJECT SPECIFICATIONS

(*) ITEMS MARKED THIS SHALL BE SUBMITTED TO ENGINEER FOR OWNERS RECORD ONLY AND WILL NOT HAVE THE ENGINEERS SHOP DRAWINGS STAMP AFFIXED

(*) ITEMS MARKED THIS SHALL BE SUBMITTED TO THE OWNERS TESTING AGENCY FOR THEIR REVIEW

B. ALL SHOP DRAWINGS MUST BE REVIEWED AND STAMPED BY THE GENERAL CONTRACTOR PRIOR TO SUBMITTAL

C. THE OMISSION FROM THE SHOP DRAWINGS OF ANY MATERIAL REQUIRED BY THE CONTRACT DOCUMENTS TO BE FURNISHED SHALL NOT RELIEVE THE CONTRACTOR OF THE RESPONSIBILITY OF FURNISHING AND INSTALLING SUCH MATERIALS, REGARDLESS OF WHETHER THE SHOP DRAWINGS HAVE BEEN REVIEWED AND APPROVED

3. MANUFACTURERS LITERATURE

SUBMIT MANUFACTURERS LITERATURE FOR ALL MATERIALS AND PRODUCTS USED IN CONSTRUCTION ON THE PROJECT

4. DESIGN CALCULATIONS

THE GENERAL CONTRACTOR SHALL SUBMIT FOR ENGINEER REVIEW DESIGN CALCULATIONS SEALED BY A REGISTERED ENGINEER IN THE STATE WHERE THE PROJECT IS LOCATED FOR THE FOLLOWING ITEMS:

A. STRUCTURAL STEEL CONNECTIONS

B. LIGHT GAUGE METAL (COLD FORMED STEEL) USED TO SUPPORT EXTERIOR CLADDING OR AS LOAD BEARING MEMBERS

5. REPRODUCTION

THE USE OF ELECTRONIC FILES OR REPRODUCTION OF THESE CONTRACT DOCUMENTS BY ANY CONTRACTOR, SUBCONTRACTOR, ERECTOR, FABRICATOR, OR MATERIAL SUPPLIER IN LIEU OF PREPARATION OF SHOP DRAWINGS SIGNIFIES THEIR ACCEPTANCE OF ALL INFORMATION SHOWN HEREON AS CORRECT, AND OBLIGATES THEMSELVES TO ANY JOB EXPENSE, REAL OR IMPLIED, ARISING DUE TO ANY ERRORS THAT MAY OCCUR HEREON.

06-DELEGATED DESIGN

1. IN ACCORDANCE WITH THE SPECIFICATIONS, THE ITEMS LISTED BELOW ARE NOT INCLUDED IN THE CONTRACT DOCUMENTS. DESIGN OF THESE ELEMENTS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR, AND SHALL BE DESIGNED AND SEALED BY A REGISTERED PROFESSIONAL ENGINEER LICENSED IN THE STATE HAVING JURISDICTION AT THE PROJECT SITE.

A. STEEL CONNECTIONS

B. COLD FORMED METAL FRAMING

C. EMBEDDED ASSEMBLIES AND INSERTS, CLAMPS, HANGERS, UNISTRUT, TRAPEZES, ETC. FOR THE SUPPORT OF MEP SYSTEMS.

D. EMBEDDED ASSEMBLIES, INSERTS, AND/OR HANGERS FOR FIRE SUPPRESSION SYSTEMS

2. DESIGN OF THE ITEMS LISTED ABOVE SHALL BE IN ACCORDANCE WITH THE GENERAL BUILDING CODE, AND SHALL INCLUDE ALL ATTACHMENTS TO THE STRUCTURE.

07-SUBSTITUTIONS

1. ALL REQUESTS FOR SUBSTITUTIONS OF MATERIALS OR DETAILS SHOWN IN THE CONTRACT DOCUMENTS SHALL BE SUBMITTED FOR APPROVAL DURING THE BIDDING PERIOD.

2. ONCE BIDS ARE ACCEPTED, PROPOSED SUBSTITUTIONS WILL BE CONSIDERED ONLY WHEN THEY ARE OFFICIALLY SUBMITTED WITH AN IDENTIFIED SAVINGS (MONETARY OR TIME) TO BE DEDUCTED FROM THE CONTRACT AND OR SCHEDULE.

08-EXISTING CONDITIONS

1. FIELD VERIFY ALL RELEVANT DIMENSIONS AND CONDITIONS AT EXISTING STRUCTURES PRIOR TO STARTING SHOP DRAWINGS AND THE CONSTRUCTION PROCESS IN THOSE AREAS. SUBMIT APPROPRIATE PLANS AND DETAILS REFLECTING THE FIELD VERIFIED EXISTING CONDITIONS FOR THE ARCHITECT'S USE.

2. EXISTING CONDITIONS WHICH REQUIRE MODIFICATIONS TO THE DESIGN OF THE PROPOSED CONSTRUCTION SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE ARCHITECT.

3. THE TESTING LABORATORY SHALL EXAMINE AND REPORT ON THE CONDITION OF PORTIONS OF THE EXISTING STRUCTURE WHICH WILL BE ALTERED OR WHICH WILL SUPPORT NEW FRAMING, WITH SPECIAL EMPHASIS ON THE FOLLOWING:

a. EXISTING BOLTED CONNECTIONS: IDENTIFY MISSING, DAMAGED, OR OTHERWISE DEGRADATED BOLTS AND CONNECTION PLATES.

b. EXISTING WELDED CONNECTIONS: VERIFY THAT WELDS WERE COMPLETED AND ARE STILL IN GOOD CONDITION, SUITABLE FOR SUPPORT OF ADDITIONAL LOADS SHOWN ON DRAWINGS.

c. GENERAL CONDITION OF FRAMING IN AREAS TO BE LOADED OR ALTERED. CONFIGURATION AND EVIDENCE OF EXCESSIVE CORROSION OR OTHER DAMAGE SHALL BE REPORTED.

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These drawings have been prepared as one coordinated set of drawings and are complimentary. What is required by one drawing is required by all of the drawings, even if a detail or component part is not identified on every sheet. Any user's reliance on a single or select few sheet(s) of the drawings without consideration for the information included in the entire set of drawings will be at the user's sole risk and shall not form the basis for a request for additional compensation or time.



△	DATE	ISSUE
A	06/20/2025	DESIGN DEVELOPMENT
B	08/15/2025	95% CONSTRUCTION DOCUMENT
C	09/05/2025	100% CONSTRUCTION DOCUMENT
.	09/26/2025	ISSUE FOR BID

PROJECT NAME

DALLAS COUNTY GEORGE ALLEN COURTHOUSE HVAC REPLACEMENT

PROJECT ADDRESS

600 COMMERCE ST. DALLAS
TX 75202

KIRKSEY PROJECT NO

2024354

KEY PLAN

SHEET TITLE

GENERAL NOTES

SHEET NUMBER

S1.1

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George Allen Court HVAC-R24.rvt
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ABBREVIATIONS USED ON STRUCTURAL DRAWINGS

(ALL ABBREVIATIONS SHOWN ARE NOT NECESSARILY USED)

A	AB	ANCHOR BOLT
	ACI	AMERICAN CONCRETE INSTITUTE
	ADDL	ADDITIONAL
	ADJ	ADJACENT
	ADDM	ADDENDUM
	AFF	ABOVE FINISH FLOOR
	AHU	AIR HANDLING UNIT
	AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
	ALT	ALTERNATE
	ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
D	APA	AMERICAN PLYWOOD ASSOCIATION
	APPROX	APPROXIMATE
	ARCH'L	ARCHITECTURAL
	ASTM	AMERICAN SOCIETY OF TESTING MATERIALS
	AWG	AMERICAN WIRE GAGE
	AWS	AMERICAN WELDING SOCIETY

B	B/B	BACK TO BACK
	BL	BUILDING LINE
	BLDG	BUILDING
	BLKG	BLOCKING
	BM	BEAM
	BO	BLOCK-OUT
	BOS	BOTTOM OF STEEL
	BOT	BOTTOM (BOTTOM FACE, LAYER, SIDE)
	B PL	BASE PLATE
	BRDG	BRIDGING
B	BRG	BEARING
	BTWN	BETWEEN

C	C	AMERICAN STANDARD CHANNEL (STRUCTURAL SHAPE)
	C/C	CENTER TO CENTER
	CANT	CANTILEVER
	CMF	COLD FORMED METAL FRAMING
	CG	CENTER OF GRAVITY
	CI	CAST IRON
	CIR	CIRCLE
	CIRC	CIRCULAR
	CJ	CONSTRUCTION JOINT
	CL	CENTER LINE
C	CLG	CLEAR
	CLM	CONCRETE MASONRY UNIT
	COR	CORNER
	CUM	COLUMN
	C	COMPRESSION
	CONC	CONCRETE
	CONN	CONNECTION
	CONSTR	CONSTRUCTION
	CONT	CONTINUOUS
	CONTR	CONTRACTOR
C	COORD	COORDINATE
	CSI	CONSTRUCTION SPECIFICATIONS INSTITUTE
	CTJ	CONTROL JOINT
	CTR	CENTER
	CU FT	CUBIC FOOT
	CU YD	CUBIC YARD

D	D	DEPTH
	DAT	DATUM
	DBA	DEFORMED BAR ANCHOR
	DEG	DEGREE
	DEMO	DEMOLISH
	DETL	DETAIL
	DIA	DIAMETER
	DIAG	DIAGONAL
	DIM	DIMENSION
	DIV	DIVIDE
D	DL	DEAD LOAD
	DBL	DOUBLE
	DWLS	DOWELS
	DN	DOWN
	DWG	DRAWING

E	E	EAST, MODULUS OF ELASTICITY
	EA	EACH
	EF	EACH FACE
	EIFS	EXTERIOR INSULATION FINISH SYSTEM
	EJ	EXPANSION JOINT
	EL	ELEVATION
	ELEV	ELEVATOR
	ENGR	ENGINEER
	EO	EQUAL
	EQUIP	EQUIPMENT
E	EW	EACH WAY
	EXIST'G	EXISTING
	EXP	EXPANSION
	EXP BT	EXPANSION BOLT
	EJ	EXPANSION JOINT
	EXT	EXTERIOR

F	FABR	FABRICATOR
	FD	FLOOR DRAIN
	FDN	FOUNDATION
	FF EL	FINISH FLOOR ELEVATION
	FIN FLR	FINISH FLOOR
	FIN	FINISH (ED)
	FLG	FLANGE
	FLR	FLOOR
	FACE OF STUD	
	FP	FIREPROOFING
F	FS	FAR SIDE
	FT	FOOT
	FTG	FOOTING
	FV	FIELD VERIFY

G	GA	GAGE OR GAUGE
	GALV	GALVANIZED
	GB	GRADE BEAM
	GC	GENERAL CONTRACTOR
	GENL	GENERAL
	GLLAM	GLASS LAMINATE
	GR BM	GRADE BEAM

H	HEX	HEXAGON(AL)
	HK	HOOK
	HORIZ	HORIZONTAL
	HP	HIGH POINT
	HSA	HEADED STUD ANCHOR
	HSS	HOLLOW STRUCTURAL SHAPE
	HT	HEIGHT
	HVAC	HEATING VENTILATION AND AIR CONDITIONING

I	I	MOMENT OF INERTIA
	INFO	INFORMATION
	IBC	INTERNATIONAL BUILDING CODE
	ID	INSIDE DIAMETER
	IF	INSIDE FACE
	INCL	INCLUDED(YING)(SIVE)
	INS	INSULATION
	INT	INTERIOR
	INTERM	INTERMEDIATE

J	JT	JOINT
	JST	JOIST

K	K	KIP (1000 POUNDS)
	KLF	KIP PER LINEAR FOOT
	KSF	KIP PER SQUARE FOOT

L	L	LITER
	L	ANGLE (STRUCTURAL SHAPE)
	LB	POUND
	LH	LEFT HAND
	LL	LIVE LOAD
	LONG	LONGITUDIAL
	LLH	LONG LEG HORIZONTAL
	LLV	LONG LEG VERTICAL
	LT WT	LIGHT WEIGHT
	LP	LOW POINT
L	LGMS	LIGHT GAUGE METAL STUDS

M	MAU	MAKE UP AIR UNIT(S)
	MATL	MATERIAL
	N	MAXIMUM
	MB	MACHINE BOLT
	MOJ	MASONRY CONTROL JOINT
	MECHL	MECHANICAL
	MEZZ	MEZZANINE
	MFG	MANUFACTURING
	MFR	MANUFACTURER
	MID	MIDDLE
M	MIN	MINIMUM
	MISC	MISCELLANEOUS
	MO	MASONRY OPENING
	MOD	MODIFY
	M	MOMENT
	MC	MOMENT CONNECTIONS
	MTL	METAL

N	N	NORTH
	NA	NOT APPLICABLE
	NIC	NOT IN CONTRACT
	NOM	NOMINAL
	NS	NEAR SIDE (FACE)
	NTS	NOT TO SCALE

O	OC	ON CENTER
	OD	OUTSIDE DIAMETER
	OF	OUTSIDE FACE
	OFD	OVER FLOW DRAIN
	OH DR	OVERHEAD DOOR
	OPNG	OPENING
	OPR	OPPOSITE
	OH	OPPOSITE HAND
	OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

P	PAR	PARALLEL
	PAF	POWDER ACTUATED FASTENER
	PCF	POUNDS PER CUBIC FOOT
	PCI	PRESTRESSED CONCRETE INSTITUTE
	PEMB	PRE-ENGINEERED METAL BUILDING
	PROJ	PROJECTION
	PERP	PERPENDICULAR
	PL	POUNDS PER LINEAL FOOT
	PREFAB	PREFABRICATE
	PRELIM	PRELIMINARY
P	PROJ	PROJECT
	PSF	POUNDS PER SQUARE FOOT
	PSI	POUNDS PER SQUARE INCH
	PT	POST-TENSION
	PVC	POLYVINYL CHLORIDE
	PLYWD	PLYWOOD
	PVG	PAVING

Q	QC	QUALITY CONTROL
	QTY	QUANTITY

R	R	RADIUS
	RCP	REINFORCED CONCRETE PIPE
	RD	ROOF DRAIN
	REF	REFERENCE
	REINF	REINFORCE
	REQD	REQUIRED
	REV	REVISION
	RF	RIGID FRAME
	RH	RIGHT HANDED)
	RO	ROUGH OPENING
R	ROW	RIGHT OF WAY
	RTU	ROOF TOP UNIT

S	S	SOUTH
	SCH	SCHEDULE
	SECT	SECTION
	SF	SQUARE FOOT
	SHT	SHEET
	SIM	SIMILAR
	SJ	STEEL JOIST INSTITUTE
	SC	SLIP CONNECTION
	SOG	SLAB ON GRADE
	SPA	SPACE
S	SPEC	SPECIFICATION
	SST	STAINLESS STEEL
	STD	STANDARD
	STEEL	STEEL
	STIFF	STIFFENER
	STIR	STIRRUPS
	STRUCT	STRUCTURAL
	SYM	SYMMETRICAL

T	T	TENSION
	TAN	TANGENT
	TEMP	TEMPORARY
	TERR	TERRAZZO
	THK	THICKNESS
	T&B	TOP AND BOTTOM
	TOB	TOP OF BEAM
	TOC	TOP OF CURB
	TOF	TOP OF FOOTING
	TOG	TOP OF GRADE
T	TOJ	TOP OF JOIST
	TOL	TOLERANCE
	TOM	TOP OF MASONRY
	TOP	TOP OF PIER
	TOS	TOP OF STEEL
	TOW	TOP OF WALL
	TL	TOTAL LOAD
	TCX	TOP CHORD EXTENSION
	TS	TUBE STEEL
	TYP	TYPICAL
T	T&G	TONGUE AND GROOVE

U	UBC	UNIFORM BUILDING CODE
	UL	UNDERWRITERS LABORATORIES, INC.
	ULT	ULTIMATE
	UNO	UNLESS NOTED OTHERWISE

V	V	SHEAR
	VAR	VARIABLES
	VERT	VERTICAL

W	W	WEST
	WLD	WELDED
	WP	WORK POINT
	WWF	WELDED WIRE FABRIC
	WB	WIND-BRACING
	WS	WATERS TOP
	WT	WEIGHT
	W/	WITH
W	W/O	WITHOUT

CLASSES OF CONCRETE SCHEDULE

CONCRETE USAGE	EXPOSURE CLASS	MINIMUM COMPRESSIVE STRENGTH (f'c)	SLUMP (IN)	CONCRETE TYPE	MAXIMUM AGGREGATE SIZE	MAXIMUM W/CM RATION	PERMISSIBLE AIR CONTENT
MISCELLANEOUS							
MECHANICAL PAD		4000 PSI AT 28 DAYS	3-5	NWC	3/8"	0.45	N/A

NOTES:

1. TOLERANCE ON AIR CONTENT AS DELIVERED TO THE SITE TO BE +/-1.5% OF VALUE NOTED IN TABLE ABOVE.
2. WATER-SOLUBLE CHLORIDE ION CONTENT THAT IS CONTRIBUTED FROM THE INGREDIENTS INCLUDING WATER, AGGREGATES, CEMENTITIOUS MATERIALS, AND ADMIXTURES SHALL BE DETERMINED ON THE CONCRETE MIXTURE BY ASTM C1218 AT AGE BETWEEN 28 AND 42 DAYS.
3. ALTERNATIVE COMBINATIONS OF CEMENTITIOUS MATERIALS TO THOSE LISTED IN THE TABLE ABOVE ARE PERMITTED WHEN TESTED FOR SULFATE RESISTANCE AND MEETING THE CRITERIA IN SECTION 26.4.2.2 OF ACI 318-14.
4. THE MAXIMUM W/CM LIMITS IN TABLE ABOVE DO NOT APPLY TO LIGHTWEIGHT CONCRETE.
5. FOR f' EXCEEDING 5000 PSI, REDUCTION OF AIR CONTENT INDICATED IN TABLE ABOVE BY 1.0 PERCENT IS PERMITTED.
6. THE LISTED VALUES ARE FOR NON PRESTRESSED CONCRETE. IF PRE STRESSED CONCRETE MEMBER ARE USED, THE MAXIMUM WATER SOLUBLE CHLORIDE ION-CONTENT IN CONCRETE SHALL BE 0.06% FOR ALL EXPOSURE CLASSES.
7. FOR ASTM C150 CEMENTITIOUS MATERIAL, OTHER AVAILABLE TYPES OF CEMENT SUCH AS TYPE I OR TYPE III ARE PERMITTED IN EXPOSURE CLASSES 81 OR 82 IF THE C3A CONTENTS ARE LESS THAN 8 PERCENT FOR EXPOSURE CLASS 81 OR LESS THAN 5 PERCENT FOR EXPOSURE CLASS 82.
8. FOR EXPOSURE CLASS 83, THE AMOUNT OF THE SPECIFIC SOURCE OF THE POZZOLAN OR SLAG CEMENT TO BE USED SHALL BE AT LEAST THE AMOUNT THAT HAS BEEN DETERMINED BY SERVICE RECORD TO IMPROVE SULFATE RESISTANCE WHEN USED IN CONCRETE CONTAINING TYPE V CEMENT. ALTERNATIVELY, THE AMOUNT OF THE SPECIFIC SOURCE OF THE POZZOLAN OR SLAG CEMENT TO BE USED SHALL BE AT LEAST THE AMOUNT TESTED IN ACCORDANCE WITH ASTM C1012 AND MEETING THE CRITERIA IN 26.4.2.2(C) OF ACI 318-14.
9. FOR MEMBERS ASSIGNED TO EXPOSURE CLASS 82 OR 83, ADMIXTURES CONTAINING CALCIUM CHLORIDE ARE PROHIBITED.
10. WHERE APPLICABLE, WATER-SOLUBLE CHLORIDE ION CONTENT OF GROUT FOR BONDED TENDONS SHALL NOT EXCEED 0.06 PERCENT WHEN TESTED IN ACCORDANCE WITH ASTM C1218, MEASURED BY MASS OF CHLORIDE ION TO MASS OF CEMENT.
11. WHERE THE CEMENT REPLACEMENT CONTENT BY FLY ASH EXCEED 40% AND f'c IS LESS THAN 3500 PSI, THE MINIMUM COMPRESSIVE STRENGTH SHALL BE MEASURED AT 56 DAYS INSTEAD OF 28 DAYS.

'Id' TENSION DEVELOPMENT LENGTH FOR BEAM, SLAB OR WALL REBAR

(GRADE 60 UNCOATED BARS)
NORMAL WEIGHT CONCRETE

BAR SIZE	f'c=3000 PSI		f'c=4000 PSI		f'c=5000 PSI	
	Id TOP	Id BOTT	Id TOP	Id BOTT	Id TOP	Id BOTT
#3	1'-9"	1'-4"	1'-6"	1'-2"	1'-5"	1'-1"
#4	2'-4"	1'-10"	2'-1"	1'-7"	1'-10"	1'-5"
#5	3'-0"	2'-3"	2'-7"	2'-0"	2'-4"	1'-9"
#6	3'-7"	2'-9"	3'-1"	2'-4"	2'-9"	2'-1"
#7	5'-2"	4'-0"	4'-6"	3'-6"	4'-0"	3'-1"
#8	5'-11"	4'-7"	5'-2"	3'-11"	4'-7"	3'-6"
#9	6'-8"	5'-2"	5'-9"	4'-5"	5'-2"	4'-0"
#10	7'-6"	5'-10"	6'-6"	5'-0"	5'-10"	4'-6"
#11	8'-4"	6'-6"	7'-3"	5'-7"	6'-6"	5'-0"

NOTES:

1. TABULATED VALUES ARE APPLICABLE ONLY IF CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED IS NOT LESS THAN 'db', CLEAR COVER IS NOT LESS THAN 'db', AND STIRRUPS OR TIES THROUGHOUT 'ld' IS NOT LESS THAN CODE MINIMUM, OR CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED IS NOT LESS THAN 2'db AND CLEAR COVER IS NOT LESS THAN 'db'. FOR OTHER CASES, MULTIPLY TABULATED VALUES BY 1.5.
2. 'TOP' BARS ARE HORIZONTAL REBARS WITH MORE THAN 12" OF FRESH CONCRETE CAST BELOW THE BARS AT THE DEVELOPMENT LENGTH.
3. FOR LIGHT WEIGHT CONCRETE MULTIPLY THE TABULATED VALUES BY 1.3.
4. FOR EPOXY COATED BARS, MULTIPLY THE TABULATED VALUES BY 1.5 FOR BOTTOM BARS, OR BY 1.3 FOR TOP BARS.
5. FOR REINFORCEMENT OTHER THAN GRADE 60, MODIFY THE TABULATED VALUES BY THE RATIO OF THE REINFORCEMENT YIELD STRENGTH DIVIDED BY 60 KSI.

TENSION LAP SPLICES-CLASS "B"

(GRADE 60 UNCOATED BARS)
NORMAL WEIGHT CONCRETE

BAR SIZE	f'c=3000 PSI		f'c=4000 PSI		f'c=5000 PSI	
	TOP	BOTT	TOP	BOTT	TOP	BOTT
#3	2'-4"	1'-9"	2'-0"	1'-6"	1'-10"	1'-5"
#4	3'-1"	2'-4"	2'-8"	2'-1"	2'-5"	1'-10"
#5	3'-10"	3'-0"	3'-4"	2'-7"	3'-0"	2'-4"
#6	4'-8"	3'-7"	4'-0"	3'-1"	3'-7"	2'-9"
#7	6'-9"	5'-2"	5'-10"	4'-6"	5'-3"	4'-0"
#8	7'-9"	5'-11"	6'-8"	5'-2"	6'-0"	4'-7"
#9	8'-8"	6'-8"	7'-6"	5'-9"	6'-9"	5'-2"
#10	9'-10"	7'-6"	8'-6"	6'-6"	7'-7"	5'-10"
#11	10'-11"	8'-4"	9'-5"	7'-3"	8'-5"	6'-6"

NOTES:

1. TABULATED VALUES ARE APPLICABLE ONLY IF CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED IS NOT LESS THAN 'db', CLEAR COVER IS NOT LESS THAN 'db', AND STIRRUPS OR TIES THROUGHOUT 'ld' IS NOT LESS THAN CODE MINIMUM, OR CLEAR SPACING OF BARS BEING DEVELOPED OR SPLICED IS NOT LESS THAN 2'db AND CLEAR COVER IS NOT LESS THAN 'db'. FOR OTHER CASES, MULTIPLY TABULATED VALUES BY 1.5.
2. 'TOP' BARS ARE HORIZONTAL REBARS WITH MORE THAN 12" OF FRESH CONCRETE CAST BELOW THE BARS AT THE DEVELOPMENT LENGTH.
3. FOR LIGHT WEIGHT CONCRETE MULTIPLY THE TABULATED VALUES BY 1.3.
4. FOR EPOXY COATED BARS, MULTIPLY THE TABULATED VALUES BY 1.5 FOR BOTTOM BARS, OR BY 1.3 FOR TOP BARS.
5. FOR REINFORCEMENT OTHER THAN GRADE 60, MODIFY THE TABULATED VALUES BY THE RATIO OF THE REINFORCEMENT YIELD STRENGTH DIVIDED BY 60 KSI.
6. FOR CLASS 'A' SPLICE (PERMITTED ONLY WHEN NOT MORE THAN HALF THE BAR SPLICES ARE STAGGERED BY THE DISTANCE OF THE SPLICE LENGTH) USE SAME AS TENSION DEVELOPMENT LENGTH.

TYPICAL SYMBOLS LEGEND

	SECTION CUT
	ELEVATION
	PLAN DETAIL
	GRID REFERENCE
	MOMENT CONNECTION
	INDICATES BEAM BOTTOM FLANGE TO BE BRACED TO JOIST
	SLAB SPAN DIRECTION
	METAL DECK SPAN DIRECTION
	TOP OF STEEL / BOTTOM OF DECK ELEVATION
	WIND BRACING MARK
	FLOOR OR ROOF OPENING

NOTE:
ITEMS SHOWN ON THIS SYMBOLS LEGEND LIST MAY OR MAY NOT APPLY TO THIS PROJECT.
ITEMS ARE FOR REFERENCE ONLY.



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REQUIRED (STATEMENT) SPECIAL INSPECTIONS					
REQUIRED VERIFICATION AND INSPECTION OF STRUCTURAL STEEL (REF TABLE 1705.2.2 OF IBC)					
	VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD	IBC REFERENCE
1.	MATERIAL VERIFICATION OF HIGH-STRENGTH BOLTS, NUTS AND WASHERS				
	IDENTIFICATION MARKINGS TO CONFORM TO ASTM STANDARDS SPECIFIED IN THE APPROVED CONSTRUCTION DOCUMENTS.	-	X	APPLICABLE ASTM MATERIAL STANDARDS; AISC 360, SECTION A3.3	
	MANUFACTURER'S CERTIFICATE OF COMPLIANCE REQUIRED.	-	-	APPLICABLE ASTM MATERIAL STANDARDS	
2.	INSPECTION OF HIGH-STRENGTH BOLTING				
	SNUG-TIGHT JOINTS.	-	X		
	PRETENSIONED AND SLIP-CRITICAL JOINTS USING TURN-OF-NUT WITH MATCH MARKING, TWIST-OFF BOLT OR DIRECT TENSION INDICATOR METHODS OF INSTALLATION.	-	-	AISC 360, SECTION M2.5	1704.3.3
	PRETENSIONED AND SLIP-CRITICAL JOINTS USING TURN-OF-NUT WITHOUT MATCH MARKING OR CALIBRATED WRENCH METHODS OF INSTALLATION.	-	-		
3.	MATERIAL VERIFICATION OF STRUCTURAL STEEL AND COLD-FORMED STEEL DECK				
A.	FOR STRUCTURAL STEEL, IDENTIFICATION MARKINGS TO CONFORM TO AISC 360.	-	X		
B.	FOR OTHER STEEL, IDENTIFICATION MARKINGS TO CONFORM TO ASTM STANDARDS SPECIFIED IN THE APPROVED CONSTRUCTION DOCUMENTS.	-	X	ASTM A 6 OR ASTM A 568 9	
C.	MANUFACTURER'S CERTIFIED TEST REPORTS.	-	X		
4.	MATERIAL VERIFICATION OF WELD FILLER MATERIALS				
A.	IDENTIFICATION MARKING TO CONFORM TO AWS SPECIFICATION IN THE APPROVED CONSTRUCTION DOCUMENTS.	-	X	AISC 360, SECTION A3.5 AND APPLICABLE AWS A5 DOCUMENTS	
B.	MANUFACTURER'S CERTIFICATE OF COMPLIANCE REQUIRED.	-	X		
5.	INSPECTION OF WELDING				
A.	STRUCTURAL STEEL AND/OR COLD-FORMED STEEL DECK:				
	1) COMPLETE AND PARTIAL PENETRATION GROOVE WELDS	X	-		
	2) MULTIPASS FILLET WELDS	-	X		
	3) SINGLE-PASS FILLET WELDS > 5/16"	-	X	AWS D1.1	1704.3.1
	4) PLUG AND SLOT WELDS	-	-		
	5) SINGLE-PASS FILLET WELDS < = 5/16"	-	X		
	6) FLOOR AND ROOF DECK WELDS	-	X	AWS D1.3	
B.	REINFORCING STEEL:				
	1) VERIFICATION OF WELD ABILITY OF REINFORCING STEEL OTHER THAN ASTM A 706	-	X		
	2) REINFORCING STEEL-RESISTING FLEXURAL AND AXIAL FORCES IN INTERMEDIATE AND SPECIAL MOMENT FRAMES, AND BOUNDARY ELEMENTS OF SPECIAL REINFORCED CONCRETE SHEAR WALLS AND SHEAR REINFORCEMENT.	-	-	AWS D1.4 ACI 318; 3.5.2	
	3) SHEAR REINFORCEMENT	X	-		
	4) OTHER REINFORCING STEEL	-	X		
6.	INSPECTION OF STEEL FRAME JOINT DETAILS FOR COMPLIANCE				
A.	DETAILS SUCH AS BRACING AND STIFFENING	-	X		
B.	MEMBER LOCATIONS	-	X		1704.3.2
C.	APPLICATION OF JOINT DETAILS AT EACH LOCATION	-	X		
7.	INSPECTION OF SHEAR STUDS CONNECTORS				
A.	INSPECT SIZE, NUMBER, POSITIONING, AND WELDING OF SHEAR CONNECTORS	-	X		
B.	RING TEST ALL SHEAR CONNECTORS WITH A 3 LB. HAMMER	-	X		
C.	BEND ALL QUESTIONABLE STUDS TO 15 DEGREES	-	X		
8.	OPEN WEB STEEL JOISTS				
A.	INSPECT INSTALLATION, FIELD WELDING, BRIDGING OF JOISTS	-	-	SJI 43RD EDITION	
9.	WHERE FABRICATION OF STRUCTURAL LOAD-BEARING MEMBERS AND ASSEMBLIES IS BEING CONDUCTED ON THE PREMISES OF A FABRICATOR'S SHOP, SPECIAL INSPECTION OF THE FABRICATED ITEMS SHALL CONFORM TO THE SPECIAL INSPECTION REQUIREMENTS OF IBC SECTION 1704. AS SUMMARIZED ABOVE, UNLESS THE FABRICATOR HAS BEEN APPROVED IN ACCORDANCE WITH IBC SECTION 1704.2.2.				

REQUIRED VERIFICATION AND INSPECTION OF CONCRETE CONSTRUCTION (REF 1704.4 OF IBC)					
	VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD	IBC REFERENCE
1.	INSPECTION OF REINFORCING STEEL, INCLUDING PRESTRESSING TENDONS AND PLACEMENT 3.5, 7.1-7.7, 1913.4	-	X	ACI 318: 3.5, 7.1-7.7	1913.4
2.	INSPECTION OF REINFORCING STEEL WELDING IN ACCORDANCE WITH TABLE 1704.3, ITEM 5d	-	X	AWS D1.4 ACI318: 3.5.2	
3.	INSPECT BOLTS TO BE INSTALLED IN CONCRETE PRIOR TO AND DURING PLACEMENT OF CONCRETE WHERE ALLOWABLE LOADS HAVE BEEN INCREASED OR WHERE STRENGTH DESIGN IS USED	-	-	ACI 318: 8.1.3, 21.2.8	1911.5, 1912.1
4.	INSPECTION OF ANCHORS INSTALLED IN HARDENED CONCRETE	-	X	ACI 318: 3.8.6, 8.1.3, 21.2.8	1912.1
5.	VERIFYING USE OF REQUIRED DESIGN MIX	-	X	ACI 318: CH. 4, 5.2-5.4	1904.2.2, 1913.2, 1913.3
6.	AT TIME OF FRESH CONCRETE IS SAMPLED TO FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS AND DETERMINE THE TEMPERATURE OF THE CONCRETE	X	-	ASTM C 172 ASTM C 31 ACI 31 8: 5.6, 5.8	1913.10
7.	INSPECTION OF CONCRETE AND SHOTCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES	X	-	ACI 318: 5.9, 5.10	1913.6, 1913.7, 1913.8
8.	INSPECTION FOR MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES	-	X	ACI 318: 5.11-5.13	1913.9
9.	INSPECTION OF PRESTRESSED/POST-TENSIONED CONCRETE. INSPECT PLACEMENT/QUALITY, LOCATION OF PT TENDONS	-	X		
	A. APPLICATION OF POST-TENSIONED/PRESTRESSING FORCES	X	-	ACI 318: 18.20	
	B. GROUTING OF BONDED POST-TENSIONED/PRESTRESSING TENDONS IN SEISMIC-FORCE-RESISTING SYSTEM	X	-	ACI 318: 18.18.4	
10.	ERECTION OF PRECAST CONCRETE MEMBERS INCLUDING INSPECTION OF WELDS TO EMBEDS AND SUPPORTS	-	X	ACI 318: CH. 16	
11.	VERIFICATION OF IN-SITU CONCRETE STRENGTH, PRIOR TO STRESSING OF TENDONS IN POST-TENSIONED CONCRETE AND PRIOR TO REMOVAL OF SHORES AND FORMS FROM BEAMS AND STRUCTURAL SLABS	-	X	ACI 318: 6.2	
12.	INSPECT FORMWORK FOR SHAPE, LOCATIONS, AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED.	-	X	ACI 318: 6.1.1	

NOTES	
1.	THE OWNER SHALL EMPLOY QUALIFIED SPECIAL INSPECTORS TO PERFORM INSPECTIONS IN ACCORDANCE WITH THE BUILDING CODE. INSPECTORS SHALL PERFORM ALL DUTIES AND RESPONSIBILITIES AS REQUIRED BY THE BUILDING CODE. JOB SITE VISITS BY THE STRUCTURAL ENGINEER DO NOT CONSTITUTE AND ARE NOT A SUBSTITUTE FOR SPECIAL INSPECTIONS.
2.	THE SCHEDULE CONTAINS A LIST OF THE SPECIAL INSPECTION ACTIVITIES RELATED TO THE QUALITY ASSURANCE PLAN REQUIRED BY THE BUILDING CODE (IBC CHAPTER 17) FOR THE FABRICATION, ERECTION, AND CONSTRUCTION OF THE STRUCTURAL SYSTEMS AS DESCRIBED IN THE SPECIFICATION AND DRAWINGS FOR THE PROJECT. ALL INSPECTORS SHALL BE QUALIFIED BY TRAINING AND EXPERIENCE FOR THE REQUIRED INSPECTIONS AND TEST PROCEDURES. REFER TO IBC CHAPTER 17 "STRUCTURAL TESTS AND SPECIAL INSPECTIONS," AND SPECIFICATION SECTION 01 45 23 "TESTS AND INSPECTIONS" FOR SPECIFIC TEST PROCEDURES. THE SCHEDULE IS INTENDED TO BE A "STATEMENT OF SPECIAL INSPECTIONS" ACCORDING TO IBC SECTION 1704.
3.	TESTING AND INSPECTION REPORTS SHALL BE PREPARED FOR EACH INSPECTION ITEM ON A PERIODIC OR DAILY BASIS WHENEVER INSPECTIONS ARE MADE ON THAT ITEM. REPORTS SHALL BE DISTRIBUTED TO THE OWNER, CONTRACTOR, ARCHITECT, STRUCTURAL ENGINEER, AND BUILDING OFFICIAL (IF REQUESTED), FOR THEIR REVIEW, COMMENTS, AND ACTION, AS NEEDED.
4.	ARCHITECTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS REQUIRING SPECIAL INSPECTIONS PER SECTION 1705 OF THE IBC HAVE NOT BEEN LISTED HERE. REFER TO ARCH/MEP FOR SPECIAL INSPECTION REQUIREMENTS FOR THESE COMPONENTS.
5.	IT IS THE CONTRACTOR'S SOLE RESPONSIBILITY TO ENSURE THESE TESTS AND INSPECTIONS ARE PERFORMED.



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	DATE	ISSUE
A	06/20/2025	DESIGN DEVELOPMENT
B	08/15/2025	95% CONSTRUCTION DOCUMENT
C	09/05/2025	100% CONSTRUCTION DOCUMENT
	09/26/2025	ISSUE FOR BID

PROJECT NAME
DALLAS COUNTY GEORGE ALLEN COURTHOUSE HVAC REPLACEMENT

PROJECT ADDRESS
600 COMMERCE ST. DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

KEY PLAN

SHEET TITLE
REQUIRED INSPECTIONS

SHEET NUMBER

S1.3

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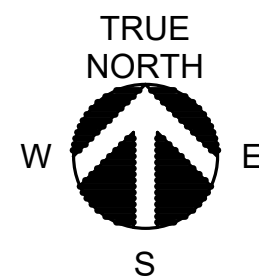


01 EXISTING FOUNDATION PLAN - LEVEL B1

1/8" = 1'-0"

PLAN NOTES:

1. FINISH FLOOR ELEVATION OF EXISTING LEVEL B1 = 64'-5" (PER EXISTING DRAWINGS)
2. NEW 4" THICK REINFORCED CONCRETE MECHANICAL PAD ON EXISTING SLAB ON GRADE AT LEVEL B1. REF 01/55.1 FOR MECHANICAL PAD REINFORCEMENT



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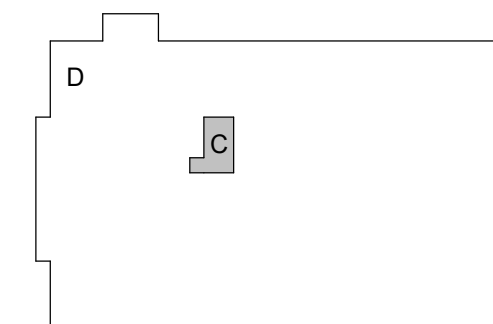
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KIRKSEY PROJECT NO. 2024354

KEY PLAN
LEVEL B1



SHEET TITLE
EXISTING FOUNDATION PLAN - LEVEL B1

SHEET NUMBER

S2.1

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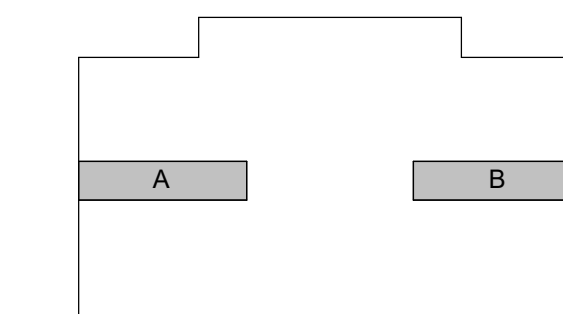
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KIRKSEY PROJECT NO. 2024354

KEY PLAN
LEVEL 9

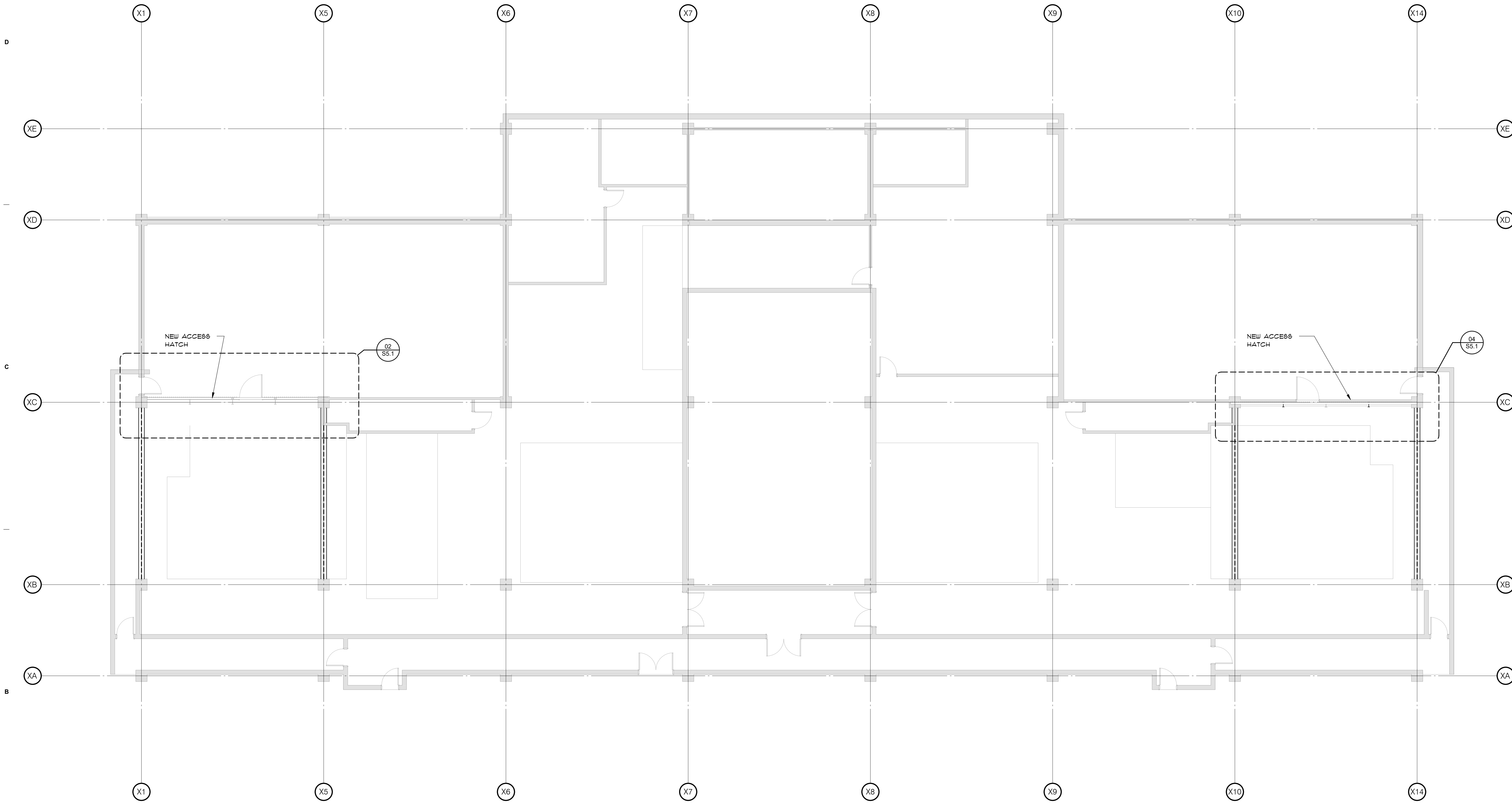


SHEET TITLE
EXISTING FLOOR FRAMING
PLAN - LEVEL 09

SHEET NUMBER

S4.1

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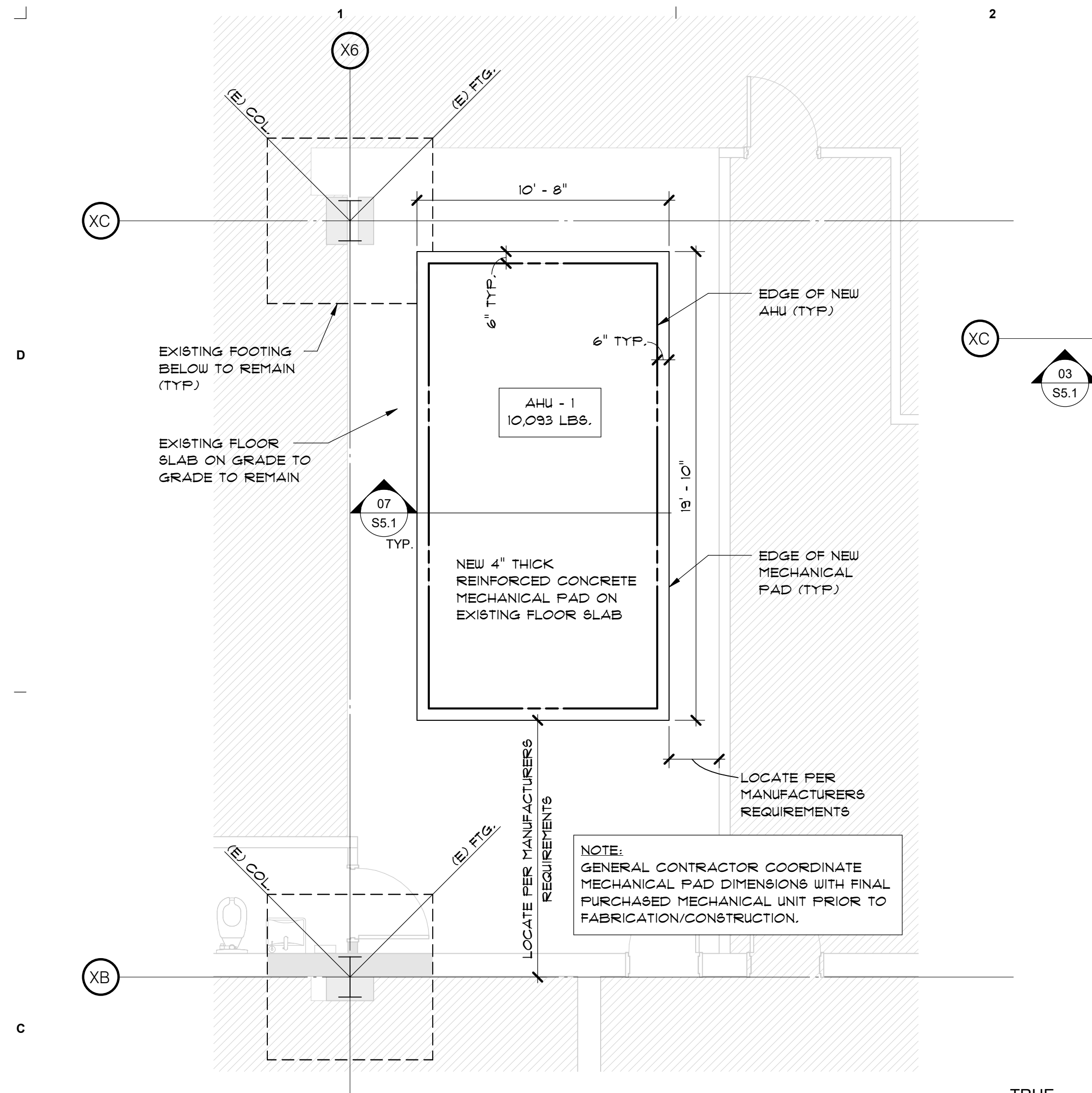
01 EXISTING FLOOR FRAMING PLAN - LEVEL 09

1/8" = 1'-0"

PLAN NOTES:

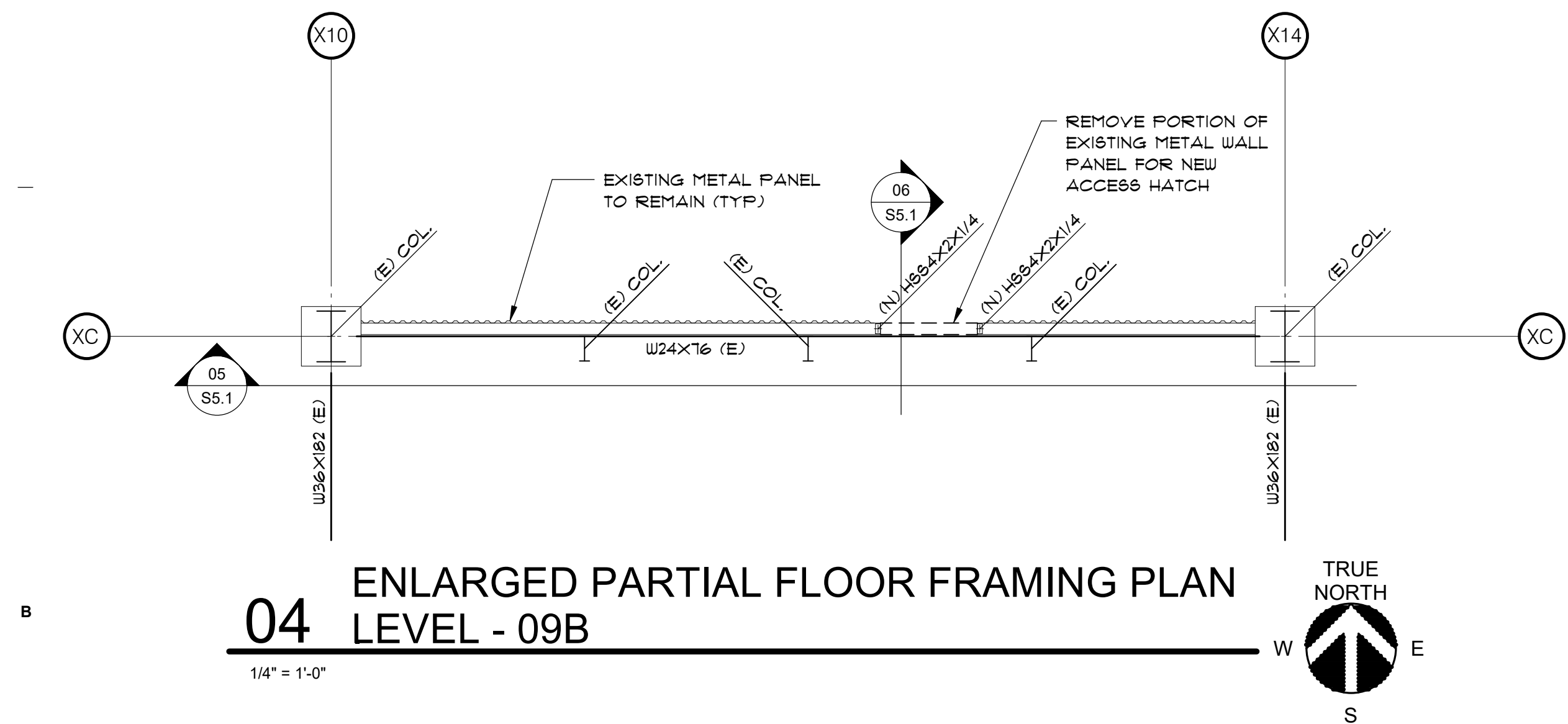
- EXISTING FINISHED FLOOR ELEVATION = 223'-1" (PER EXISTING DRAWINGS)

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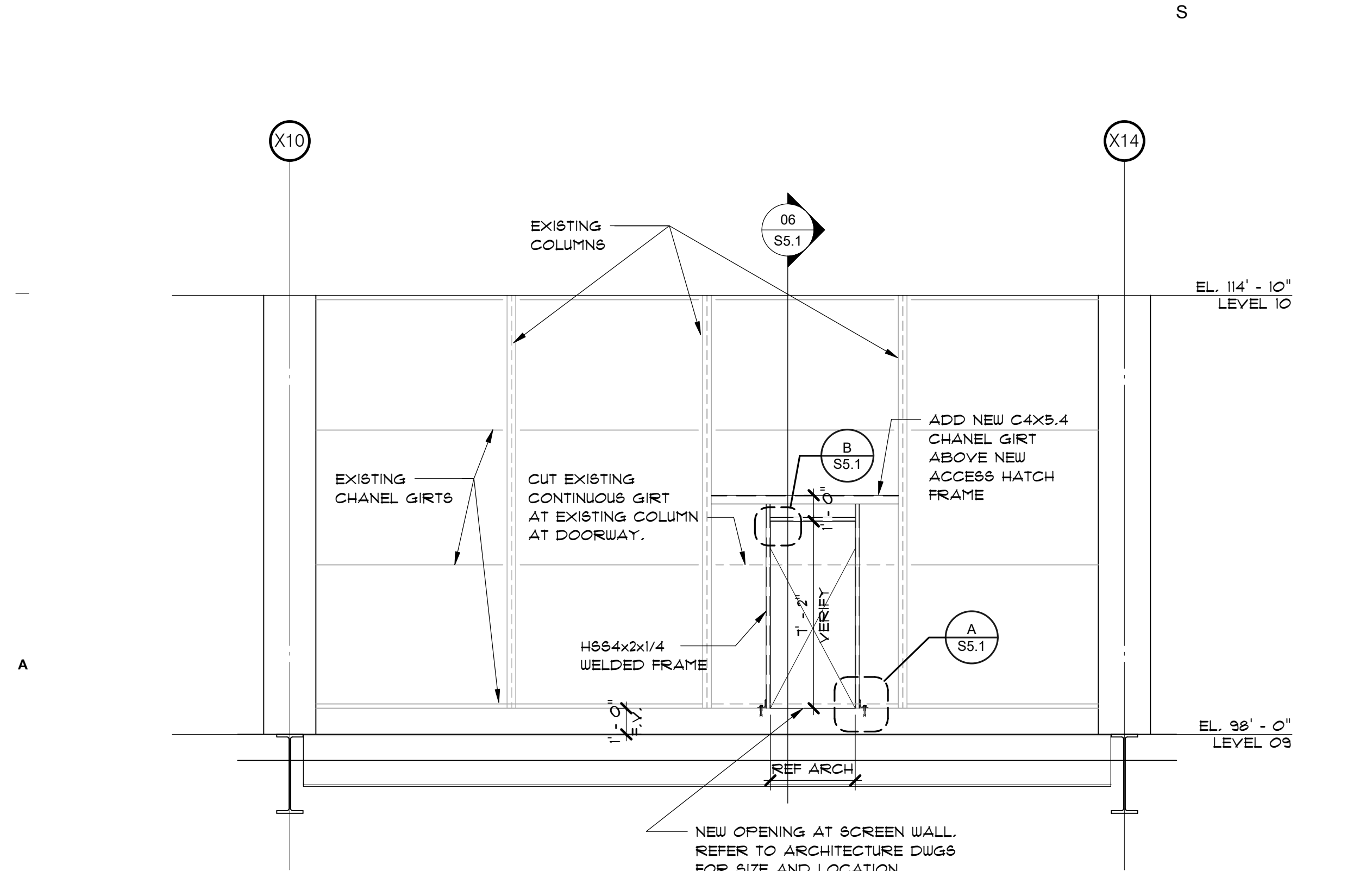
01 ENLARGED FOUNDATION PLAN - LEVEL B1

1/4" = 1'-0"



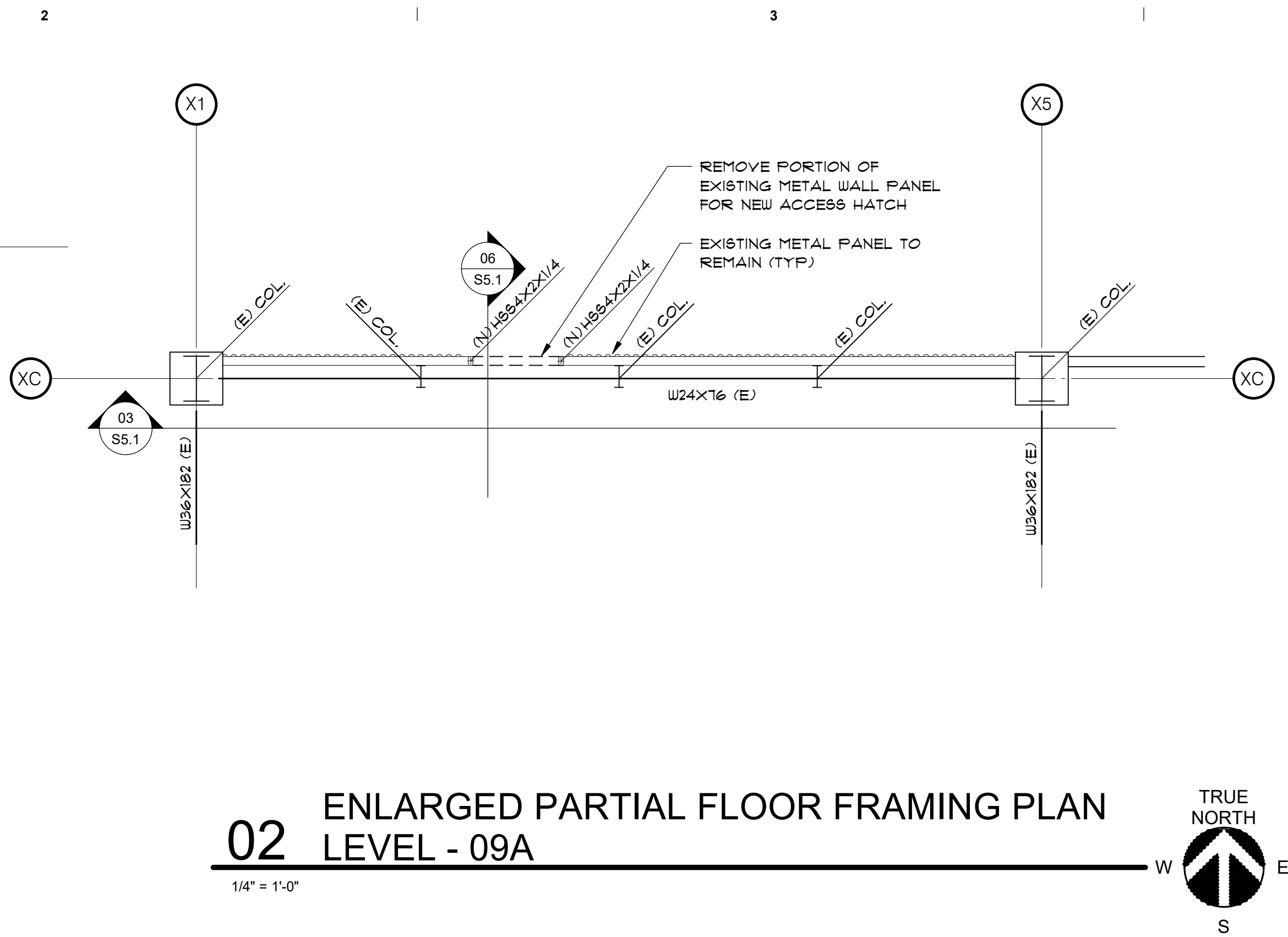
04 ENLARGED PARTIAL FLOOR FRAMING PLAN LEVEL - 09B

1/4" = 1'-0"



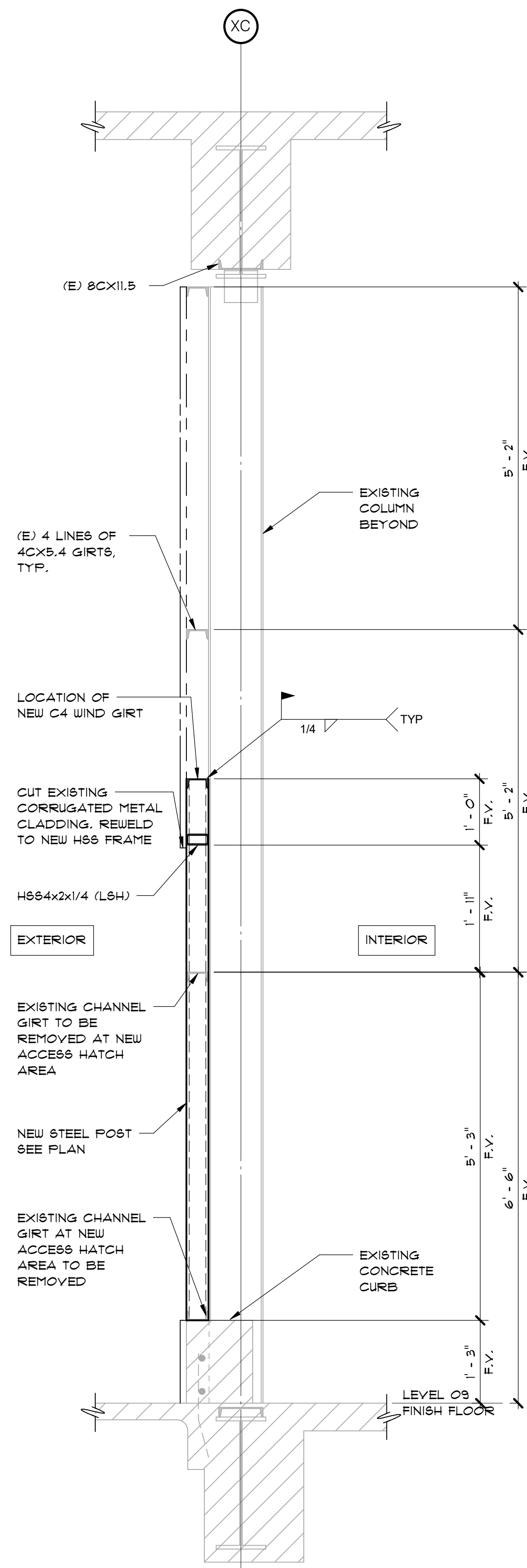
05 ELEVATION

1/4" = 1'-0"



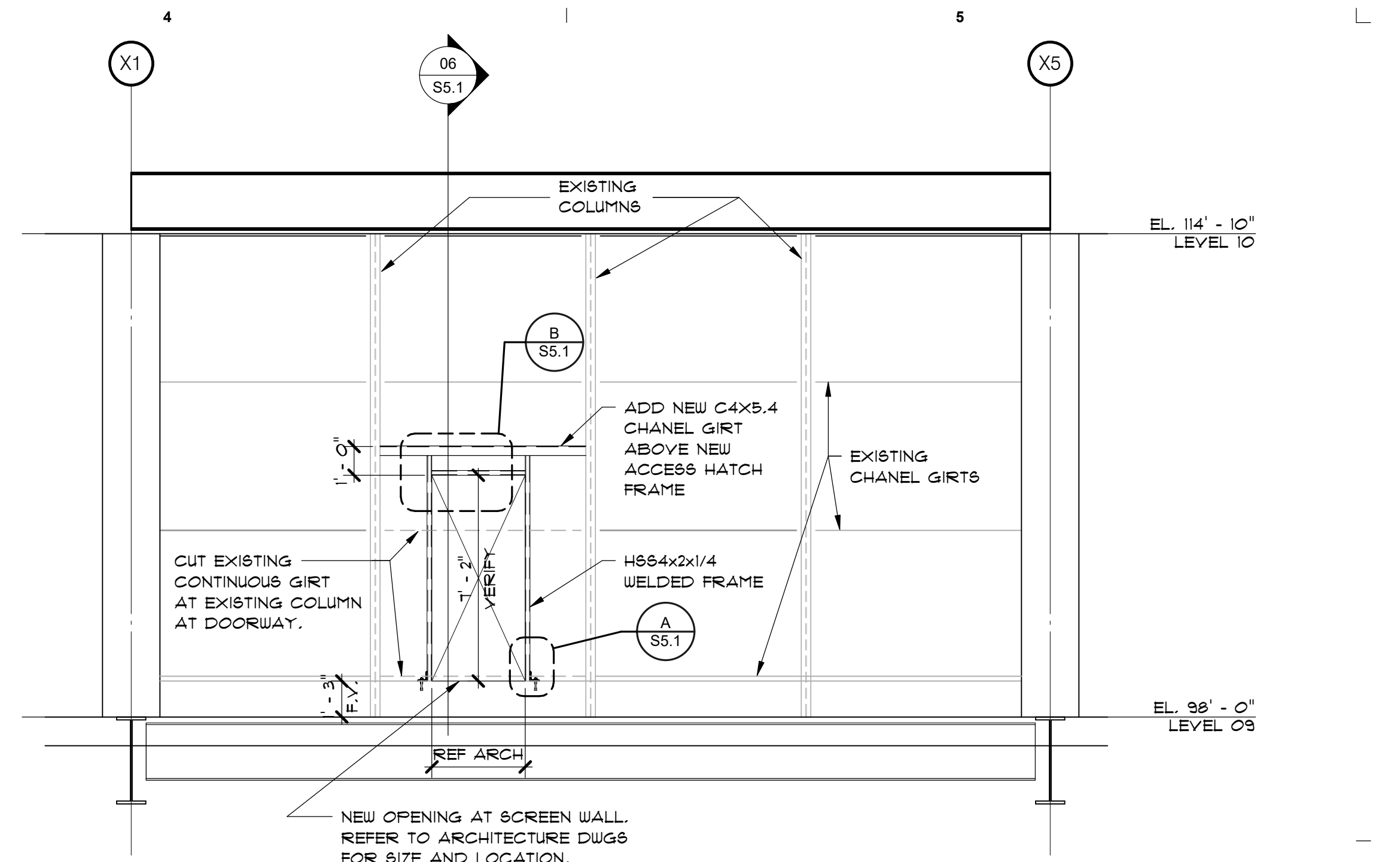
02 ENLARGED PARTIAL FLOOR FRAMING PLAN LEVEL - 09A

1/4" = 1'-0"



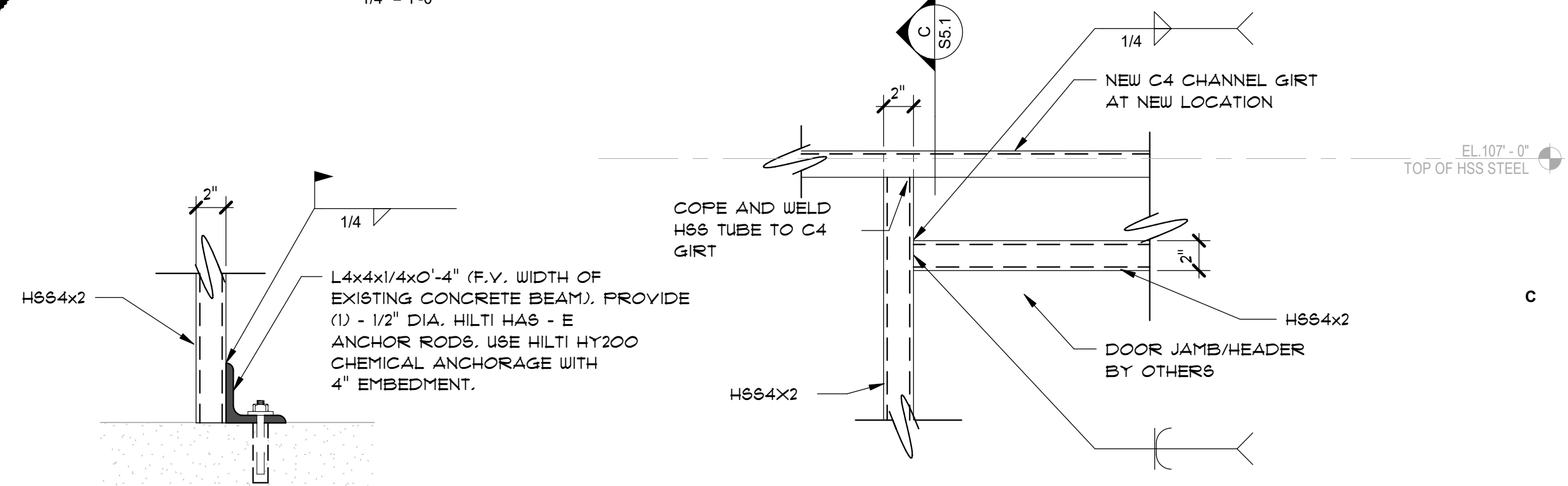
06 SECTION

3/4" = 1'-0"



03 ELEVATION

1/4" = 1'-0"



A DETAIL A

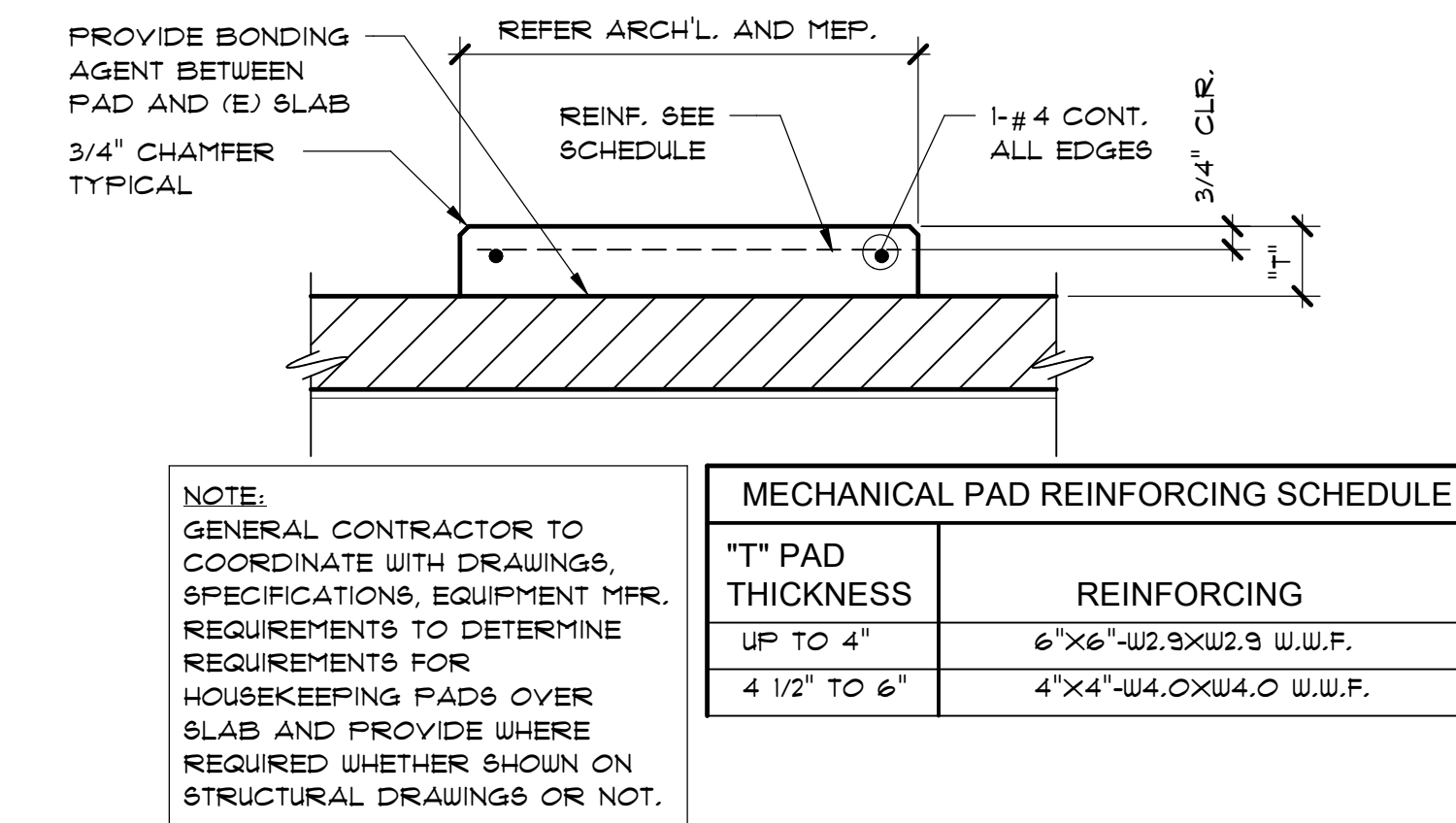
1 1/2" = 1'-0"

B DETAIL B

1 1/2" = 1'-0"

C DETAIL C

1 1/2" = 1'-0"



07 SECTION

N.T.S.



DATE	ISSUE
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KIRKSEY PROJECT NO. 2024354

KEY PLAN

SHEET TITLE
ENLARGED PLANS AND SECTIONS

SHEET NUMBER

S5.1

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ALLEN COURTHOUSE HVAC
REPLACEMENT

PROJECT ADDRESS
600 COMMERCE ST.
DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

KEY PLAN

SHEET TITLE
MECHANICAL SYMBOL
LEGEND

SHEET NUMBER

M0.01

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MECHANICAL SYMBOL LEGEND

GRAPHIC SYMBOLS	PIPE & FITTING SYMBOLS	VALVE SYMBOLS	DUCTWORK SYMBOLS	DUCTWORK SYMBOLS
DRAWING TITLE TOP TITLE BOTTOM TITLE SCALE: 1/8" = 1'-0" SCALE OF FLOOR PLAN, SECTION OR DETAIL DETAIL NO. AND SHEET NO. AREA OF ENLARGED PLAN OR DETAIL DETAIL NUMBER SHEET NO. ON WHICH ENLARGED DETAIL IS DRAWN SECTION NO. DIRECTION OF CUTTING PLANE SHEET NO. ON WHICH THE SECTION IS DRAWN	DOUBLE LINE SINGLE LINE DESCRIPTION PIPE DIRECTION OF FLOW / SLOPE PIPING WITH INSULATION (WHEN SHOWN FOR CLARITY) WELDED JOINT SCREWED JOINT FLANGED JOINT UNION GROOVED END JOINT GENERIC FLEXIBLE COUPLING (REFER TO SPECIFICATIONS) GROOVED END ADAPTER FLANGE FLANGED COUPLING ADAPTER STUB END OR FLANGE ADAPTER W/ FLANGE RING BLIND FLANGE ELBOW, 45 DEGREE (LONG RADIUS UON) ELBOW, 90 DEGREE (LONG RADIUS UON) ELBOW, 90 DEGREE - CHANGE IN DIRECTION TOWARD VIEWER ELBOW, 90 DEGREE - CHANGE IN DIRECTION AWAY FROM VIEWER TEE FITTING TEE FITTING, BRANCH TOWARD VIEWER TEE FITTING, BRANCH AWAY FROM VIEWER LATERAL REDUCER - CONCENTRIC REDUCER - ECCENTRIC CAP ANCHOR CLEANOUT THERMOWELL WITH THERMOMETER PRESSURE GAUGE WITH GAUGE COCK STRAINER - "Y" TYPE WITH BLOW DOWN AIR SEPARATOR WATER METER VENTURI FLOW METER FLOW ORIFICE PLATE STEAM TRAP, TYPE AS NOTED IB = INVERTED BUCKET F&T = FLOAT & THERMOSTATIC TH = THERMODYNAMIC BP = BALANCED PRESSURE PUMP, ARROW INDICATES FLOW NOTE: WELDED FITTINGS ARE SHOWN FOR DOUBLE LINE PIPING. FITTINGS WITH OTHER END CONDITIONS ARE SIMILAR.	DOUBLE LINE SINGLE LINE DESCRIPTION GATE VALVE BUTTERFLY VALVE BALL VALVE DIAPHRAGM VALVE GLOBE VALVE PLUG VALVE CHECK VALVE PRESSURE REDUCING VALVE BALANCING VALVE PRESSURE RELIEF VALVE AUTOMATIC AIR VENT MANUAL AIR VENT CONTROL VALVES DOUBLE LINE SINGLE LINE DESCRIPTION TWO-WAY, TWO POSITION CONTROL VALVE TWO-WAY, TWO POSITION CONTROL VALVE W/ SOLENOID TWO-WAY, MODULATING CONTROL VALVE THREE-WAY, TWO POSITION CONTROL VALVE THREE-WAY, MODULATING CONTROL VALVE CONTROL SYMBOLS WALL MOUNTED DEVICES TEMPERATURE SENSOR/THERMOSTAT HUMIDITY SENSOR/HUMIDISTAT MOTION SENSOR VERRIDE SWITCH CARBON DIOXIDE SENSOR CARBON MONOXIDE SENSOR VARIABLE FREQUENCY DRIVE EQUIPMENT SYMBOLS ROOFTOP EXHAUST FAN (ROOF PLAN VIEW) ROOFTOP EXHAUST FAN (ROOF PLAN VIEW) INLINE EXHAUST FAN (EF), AIR HANDLING UNIT (AHU), CONDENSING UNIT (CU) WALL LOUVER WITH POSITIVE OR NEGATIVE AIRFLOW DOOR UNDERCUT (SPECIFY CFM IF REQUIRED) DOOR LOUVER (SPECIFY CFM IF REQUIRED)	DOUBLE LINE SINGLE LINE DESCRIPTION RECTANGULAR OR SQUARE DUCT, DIMENSIONS ARE IN INCHES, MIN. INSIDE CLEAR, A = WIDTH, B= HEIGHT ROUND DUCT DIMENSIONS ARE IN INCHES, MIN. INSIDE CLEAR, A = DIAMETER FLAT OVAL DUCT DIMENSIONS ARE IN INCHES, MIN. INSIDE CLEAR, A = WIDTH, B= HEIGHT DUCTWORK RISE (R) OR DROP (D) RELATIVE TO DIRECTION OF AIRFLOW DIRECTION OF AIR FLOW SUPPLY AIR OR POSITIVE PRESSURE DUCTWORK, SECTION TOWARDS/AWAY VIEWER SUPPLY AIR OR POSITIVE PRESSURE DUCTWORK, AIRFLOW AWAY FROM VIEWER RETURN AIR OR NEGATIVE PRESSURE DUCTWORK, AIRFLOW TOWARDS VIEWER RETURN AIR OR NEGATIVE PRESSURE DUCTWORK, AIRFLOW AWAY FROM VIEWER EXHAUST AIR DUCTWORK, AIRFLOW TOWARDS VIEWER EXHAUST AIR DUCTWORK, AIRFLOW AWAY FROM VIEWER RIGID ROUND DUCTWORK, AIRFLOW TOWARDS VIEWER RIGID ROUND DUCTWORK, AIRFLOW AWAY FROM VIEWER TRANSITION - ECCENTRIC REDUCER TRANSITION - CONCENTRIC REDUCER TRANSITION - SQUARE TO ROUND 90° ELBOW WITH TURNING VANES (REQUIRED ON SUPPLY DUCTWORK) 90° ELBOW WITHOUT TURNING VANES (RETURN OR EXHAUST DUCTWORK ONLY) 45° ELBOW WITH TURNING VANES (REQUIRED ON SUPPLY DUCTWORK) 45° ELBOW WITHOUT TURNING VANES (RETURN OR EXHAUST DUCTWORK ONLY) RADIUS 90° ELBOW (R = 1.5W) RADIUS 45° ELBOW (R = 1.5W) SPIN-IN FITTING WITH FLEXIBLE DUCTWORK, DIMENSIONS ARE IN INCHES, MIN. INSIDE CLEAR, A = DIAMETER BRANCH TAKE-OFF WITH MVD CONICAL TAKE-OFF WITH MVD MANUAL VOLUME DAMPER FIRE DAMPER FIRE/SMOKE DAMPER SMOKE DAMPER BACKDRAFT DAMPER MOTORIZED DAMPER BAROMETRIC DAMPER SMOKE DETECTOR	DOUBLE LINE SINGLE LINE DESCRIPTION STATIC PRESSURE SENSOR TEMPERATURE SENSOR HUMIDITY SENSOR CARBON DIOXIDE SENSOR DIFFERENTIAL PRESSURE SENSOR DIFFERENTIAL PRESSURE SAFETY SHUT-DOWN RELAY AIRFLOW PROOF SWITCH ACCESS PANEL/CLEANOUT AIR DISTRIBUTION REFER TO SCHEDULE FOR ADDITIONAL INFORMATION SUPPLY AIR DIFFUSER RETURN AIR OR TRANSFER AIR GRILLE EXHAUST AIR GRILLE ROUND SUPPLY AIR DIFFUSER LINEAR SLOT DIFFUSER CEILING RADIATION DAMPER SIDEWALL REGISTER DUCT MOUNTED GRILLE AIR DISTRIBUTION CALLOUT THIS IS A STANDARD LEGEND SHEET. SOME INFORMATION ON THIS SHEET MAY NOT NECESSARILY APPLY TO THIS PROJECT.

A

B

C

D

A

B

C

D

ABBREVIATIONS

A (O5)	COMPRESSED AIR (WORKING PRESS.)	FCU	FAN COIL UNIT	POS	POSITIVE
AAV	AUTOMATIC AIR VENT	FDO	FLOOR DRAIN	PR	PUMPED RETURN
ABV	ABOVE	°F	FAHRENHEIT (DEGREES)	PRG	PRESSURE GAUGE
AC	ALTERNATING CURRENT	FLA	FULL LOAD AMPS	PH	PHASE
ACU	AIR CONDITIONING UNIT	FLG	FLANGE	PHC	PREHEAT COIL
ADU	AIR CONDITIONING UNIT	FMS	FACILITY MANAGEMENT SYSTEM	PRV	PRESSURE REDUCING VALVE
ADF	ACCESS DOOR, AREA DRAIN	FMB	FLOT ON BOTTOM	PRM	PARTS PER MILLION
AFF	ABOVE FINISHED FLOOR	FMT	FLOT ON TOP	PLB	PLUMBING
AHU	AIR HANDLING UNIT	FPI	FAN POWERED BOX	PLBG	PRESSURE
AI	ANALOG INPUT	FPS	FEET PER INCH	PS	PRESSURE SWITCH
ALT	ALTIMETER	FS	FEET PER SQUARE FOOT	PSP	POUNDS PER SQUARE FOOT
AMB	AMBIENT	FPS	FEET PER SECOND	PSI	POUNDS PER SQUARE INCH
AMP	AMPERE	FRP	FIBERGLASS REINFORCED PLASTIC	PSIG	POUNDS PER SQUARE INCH GAUGE
AMP	ANALOG OUTPUT	FT	FOOT, FEET	PTAC	PACKAGED TERMINAL A/C
AP	ACCESS PANEL	FT LB	FOOT-POUND		
APD	AIR PRESSURE DROP			Q	TOTAL, TOTAL HEAT
APPROX	APPROXIMATE	GA	GAUGE, GAGE	QTY	QUANTITY
AS	AIR SEPARATOR	GAL	GALLON		
ASC	ABOVE SUSPENDED CEILING	GALV	GALVANIZED		
AU	AUTHORITY HAVING JURISDICTION	GEN	GENERATOR	R	RELIEF, THERMAL RESISTANCE
AUG	AUTOMATIC	GPH	GALLONS PER HOUR	RET	RETURN AIR
AWG	AMERICAN WIRE GAUGE	GPM	GALLONS PER MINUTE	RAC	ROOM AIR CONDITIONER
		GSW	GROUNDWATER SOURCE	RECT	RECTANGULAR
		GTE	GATE VALVE	REFR	REFRIGERATION
BAS	BELL & SPIGOT	HC	HEATING COIL	RET	RETURN
BB	BACK TO BACK	HEAD	HEAD	RED	REDUCER
BAL	BALANCE	HGT	HEIGHT	REV	REVOLUTIONS
BBR	BASE BOARD RADIATOR	HG	HEAT GAIN	REFR	REFERENCE
BFG	BELOW FINISHED GRADE	HGT	HEIGHT	RHC	REHEAT COIL
BFV	BUTTERFLY VALVE	HPC	HIGH PRESSURE CONDENSATE	RHG	REFRIGERANT HOT GAS
BFW	BOILER FEED BOOSTER PUMP	HPS	HIGH PRESSURE STEAM (>100 PSI)	RHV	REHEAT VALVE
BFG	BELOW FINISHED GRADE	HR	HOUR	RL	REFRIGERANT LIQUID
BLDG	BUILDING	HS	HUMIDITY SENSOR	RL	REFRIGERANT PER MINUTE
BHR	BRKAKE HORSEPOWER	HST	HUMIDISTAT	ROPS	REVOLUTIONS PER SECOND
BLF	BLAKE	HVAC	HEATING, VENTILATION AND A/C	RTU	REFRIGERANT SUCTIION
BOD	BLOW OFF	HW	HEATING WATER	RV	ROOF TOP UNIT
BOP	BOTTOM OF DUCT	HWB	HEATING WATER BOILER		
BOP	BOTTOM OF PIPE	HWC	HEATING WATER COIL	S	SECOND
BOS	BOTTOM OF STEEL	HWP	HEATING WATER CIRCULATING PUMP	SA	SUPPLY AIR
BOU	BOILING POINT UNIT	HW	HEATING WATER PUMP	SAT	SATURATION
BTU	BRITISH THERMAL UNIT PER HOUR	HWS	HEATING WATER RETURN	SC	SHADING COEFFICIENT
BAV	BALL VALVE	HWT	HEATING WATER TANK	SEER	SEASONAL ENERGY RATIO
BYP	BYPASS	HZ	HERTZ (FREQUENCY)	SF	SQUARE FEET
		I/O	INPUT/OUTPUT	SG	SENSIBLE GRAVITY, STEAM GAUGE
°C	CELSIUS (DEGREES)	IN	INSIDE DIAMETER	SH	SENSIBLE HEAT
CC	COOLING COIL	IE	INSEIT ELEVATION	SHG	SENSIBLE HEAT GAIN
CAP	CAPACITY	IN	INCHES WATER COLUMN	SHG	SOLAR HEAT GAIN COEFFICIENT
CD	CONDENSATE DRAIN	IN	INCHES WATER COLUMN	SHR	SENSIBLE HEAT RATIO
CF	CHEMICAL FEED	INW	INVERT	SOLENOID VALVE	
CFM	CUBIC FEET PER MINUTE	IOV	INSTALLATION, OPERATION, AND MAINTENANCE	SOV	SHUT OFF VALVE
CFS	CUBIC FEET PER SECOND	IP	IRON PIPE	SP	STATIC PRESSURE, PUMP PUMP
CH	CHILLER	IP	IRON PIPE	SPC	SPECIFICATION
CHW	CHILLED WATER	IP	IRON PIPE SIZE, INCHES PER SECOND	SPLY	SUPPLY
CHWP	CHILLED WATER PRIMARY PUMP	IP	IRON PIPE THREADED	SPS	STATIC PRESSURE SENSOR
CHWR	CHILLED WATER RETURN	IR	INFRARED	SQ	SQUARE
CHW	CHILLED WATER SUPPLY	IR	INDIRECT WASTE	SSF	STAINLESS STEEL PIPE
CHWSP	CHILLED WATER SECONDARY PUMP	K	KELVIN, THERMAL CONDUCTIVITY	STD	STANDARD
CI	CAST IRON	KIP	THOUSAND POUNDS	STR	STEAM
CIP	CAST IRON PIPE	KIP FT	THOUSAND FOOT-POUNDS	STR	STRAINER
CKT	CIRCUIT	KW	KILOWATT	STWP	STEAM WORKING PRESSURE
CKV	CHECK VALVE	KWH	KILOWATT HOUR	SUCTION	SUCK
CL	CENTER LINE ()	LB	LEAVING AIR TEMPERATURE	SUP	SUPPLY
CONN	CONNECTION	LB	LEAVING AIR TEMPERATURE	SV	SAFETY VALVE
CPD	CONDENSATE PUMP DISCHARGE	LB	LEAVING AIR TEMPERATURE		
CRAC	COMPUTER ROOM A/C UNIT	LB	LEAVING AIR TEMPERATURE		
CRP	CONDENSATE RETURN PUMP	LB	LEAVING AIR TEMPERATURE		
CR	CONDENSATE RETURN	LB	LEAVING AIR TEMPERATURE		
CR	CONDENSATE RETURN	LB	LEAVING AIR TEMPERATURE		
CU	COOLING TOWER	LB	LEAVING AIR TEMPERATURE		
CU	CONDENSING UNIT	LB	LEAVING AIR TEMPERATURE		
CU FT	CUBIC FEET	LB	LEAVING AIR TEMPERATURE		
CU IN	CUBIC INCH	LB	LEAVING AIR TEMPERATURE		
CUH	CABINET UNIT HEATER	LB	LEAVING AIR TEMPERATURE		
CW	COEFFICIENT - VALVE FLOW	LB	LEAVING AIR TEMPERATURE		
CW	COLD WATER (POTABLE)	LB	LEAVING AIR TEMPERATURE		
CWP	CONDENSER WATER PUMP	LB	LEAVING AIR TEMPERATURE		
CW	CONDENSING WATER RETURN	LB	LEAVING AIR TEMPERATURE		
CWS	CONDENSER WATER SUPPLY	LB	LEAVING AIR TEMPERATURE		
		LB	LEAVING AIR TEMPERATURE		
D	DRAIN	LB	LE		
D	DRAIN	LB	LE		
D	DRAIN	LB	LE		
DB	DRY BULB TEMPERATURE	mA	MILLIAMPERES	V	VOLTS
DBT	DRY BULB TEMPERATURE	max	MAXIMUM	VAC	VARIABLE
DEC	DECEMBER	MC	MINIMUM CIRCUIT AMPACITY	VAV	VARIABLE AIR VOLUME
DC	DIRECT CURRENT	MCC	MINIMUM CONTROL CENTER	VDC	VOLTS DIRECT CURRENT
DDG	DIRECT DIGITAL CONTROL	MCM	MINIMUM	VEL	VELOCITY
DEG	DEGREES (CELSIUS OR FAHRENHEIT)	MN	MAXIMUM OVERCURRENT PROTECTION	VENT	VENT
DE	DEGREE	MOCP	MINIMUM OPERATED VALVE	VERT	VERTICAL
DEWPT	DEW POINT TEMPERATURE	MOV	MEDIUM PRESSURE	VFD	VARIABLE FREQUENCY DRIVE
DIA	DIAMETER	MPC	MEDIUM PRESSURE CONDENSATE	VFQ	VENTILATION
DIP	DRAIN-OUT PIPE	MPS	MEDIUM PRESSURE STEAM (16-99 PSI)	VRF	VARIABLE REFRIGERANT FLOW
DOV	DRAIN OFF VALVE	MPT	MALE PIPE THREAD	VSD	VARIABLE SPEED DRIVE
DPS	DIFFERENTIAL PRESSURE SENSOR	MS	MILIE-PIECE		
DPT	DIFFERENTIAL PRESSURE TRANSMITTER	MV	MANUAL VOLUME DAMPER	W	WATT
DISC	DISCONNECT SWITCH	N/A	NOT APPLICABLE	WB	WET BULB
DVV	DRAIN, WASTE & VENT	NC	NOISE CRITERIA, NORMALLY CLOSED	WBT	WET BULB TEMPERATURE
		NC	NOT IN CONTRACT	WC	WATER COLUMN
EA	EXHAUST AIR	NO	NORMALLY OPEN, NUMBER	WG	WATER GAGE
EAP	ELECTRIC PNEUMATIC	NP	NOMINAL PIPE SIZE	WH	WATER HEATER
EAT	ENTERING AIR TEMPERATURE	NR	NOISE REDUCTION	WL	WATER LINE
ECP	ELECTRIC PNEUMATIC	NRS	NOISE REDUCTION COEFFICIENT	WLD	WELDED
ECU	EVAPORATIVE COOLING UNIT	NTC	NOT TO SCALE	WM	WATER METER
EDBT	ENTERING DRY BULB TEMPERATURE			WNF	WELD NECK FLANGE
EDH	ELECTRIC DUCT HEATER			WP	WATER PUMP
EER	ENERGY EFFICIENCY RATIO			WPD	WATER PRESSURE DROP
EF	EXHAUST FAN	OA	OUTSIDE AIR	WPR	WORKING PRESSURE DROP
EFF	EFFICIENCY	OA	OUTSIDE AIR FAN	WSP	WATER SOURCE HEAT PUMP
ELEV	ELEVATION	OD	OPPOSED BLADE DAMPER	WSP	WORKING STEAM PRESSURE
ENT	ENTERING	OZ	OUNCE	WT	WEIGHT
EOV	ELECTRONICALLY OPERATED VALVE	P	PUMP	YD	YARD, YARD DRAIN
EXP	EXTERNAL STATIC PRESSURE	PE	PNEUMATIC ELECTRIC	ZR	YEAR
ET	EXPANSION TANK	%	PERCENT		
EUH	ELECTRIC UNIT HEATER	PC	PUMPED CONDENSATE		
EVAP	EVAPORATOR	PCD	PRECOOL COIL		
EWBT	ENTERING WET BULB TEMPERATURE	PDD	PRESSURE DROP		
EWT	ENTERING WATER TEMPERATURE				
EXCH	EXCHANGER				
EXH	EXHAUST				
EXP	EXPANSION				

MECHANICAL GENERAL NOTES

- ISOLATION VALVES SHALL BE PROVIDED IN ALL BRANCH PIPING AND AT EQUIPMENT CONNECTIONS.
- PIPING CONNECTIONS TO ALL EQUIPMENT SHALL BE FABRICATED WITH THE ISOLATION VALVES, FLANGES AND/OR UNIONS POSITIONED TO ALLOW REMOVAL AND SERVICE OF THE COMPONENT PARTS.
- INSTALL MANUAL AIR VENTS AT THE HIGH POINTS OF THE PIPING SYSTEMS.
- ROUTE PIPING IN AN ORDERLY MANNER AND MAINTAIN PROPER GRADES. INSTALL TO CONSERVE HEADROOM AND TO CREATE MINIMUM INTERFERENCE WITH USE OF SPACE. ROUTE ALL PIPING PARALLEL TO BUILDING LINES UNO. GROUP PIPING AT COMMON ELEVATIONS WHENEVER PRACTICAL. PIPES LOCATED IN CONCEALED SPACES SHALL BE ROUTED CLOSE TO BUILDING STRUCTURE UNO.
- INSTALL PIPING TO ALLOW FOR EXPANSION AND CONTRACTION WITHOUT STRESSING PIPE OR EQUIPMENT CONNECTED.
- INSTALL VALVES WITH STEMS UPRIGHT OR HORIZONTAL, NOT INVERTED.
- INSTALL VALVES AND EQUIPMENT IN ACCESSIBLE LOCATIONS. INSTALL ACCESS DOORS IN PARTITIONS OR CEILINGS WHERE VALVES AND EQUIPMENT WOULD OTHERWISE BE INACCESSIBLE.
- WHEN SOCKET WELD OR SOLDER END VALVES ARE INSTALLED, SPECIAL CARE SHALL BE TAKEN TO AVOID OVERHEATING AND DAMAGING THE VALVE BODY, TRIM OR PACKING. DAMAGED VALVES SHALL BE REPLACED AT CONTRACTOR'S EXPENSE.
- IDENTIFY EACH PIPE WITH LABELING AS REQUIRED BY SPECIFICATIONS.
- SLEEVE ALL PIPING THAT PENETRATES FIRE RATED WALLS, FLOORS AND PARTITIONS. PENETRATIONS SHALL BE SEALED WITH A U.L. LISTED ASSEMBLY TO PROVIDE A RATING EQUAL TO OR GREATER THAN THAT OF THE PENETRATED WALL, FLOOR OR PARTITION.
- SLEEVE ALL PIPING THAT PENETRATES EXTERIOR BUILDING WALLS AND GRADE BEAMS. SEAL PENETRATIONS WATER TIGHT.
- COORDINATE WITH OTHER TRADES BEFORE FABRICATION OR INSTALLATION OF ANY SYSTEMS.
- EXISTING DUCTWORK, PIPING AND EQUIPMENT SHOWN ON THESE DRAWINGS INDICATES THE GENERAL LOCATION AND ROUTING. THE ACTUAL LOCATION SHALL BE DETERMINED BY THE CONTRACTOR WHO SHALL COORDINATE ALL WORK WITH ALL TRADES NECESSARY TO INSTALL NEW DUCTWORK, PIPING OR EQUIPMENT AS SHOWN ON THE DRAWING.
- THESE DRAWINGS DO NOT NECESSARILY SHOW ALL OFFSETS OR ELEVATION DIFFERENCES WHICH MAY BE NECESSARY FOR THE COMPLETE INSTALLATION. THESE SHALL BE PROVIDED AS REQUIRED TO PROVIDE A COMPLETE AND FUNCTIONAL SYSTEM AT NO ADDITIONAL COST TO THE CONTRACT.
- ALL NEW DUCTWORK SHALL BE EXTERNALLY INSULATED AS SPECIFIED.
- WHERE REMOVAL OF EXISTING DUCTWORK OR PORTIONS OF ANY AIR SYSTEM IS NECESSARY, THE DUCT SHALL BE PATCHED AND SEALED AIR TIGHT USING PATCH OF SAME MATERIAL AND EQUAL OR GREATER THICKNESS AS EXISTING. PATCHES SHALL BE ATTACHED WITH SHEET METAL SCREWS OR OTHER MEANS OF POSITIVE ATTACHMENT (WELDING, BONDING, ETC.) AS SPECIFIED FOR THE PARTICULAR DUCT SYSTEM. NEW INSULATION SHALL BE EQUAL TO OR BETTER THAN EXISTING AND SHALL BE PATCHED AND SEALED TO MATCH EXISTING INSULATION AND MAINTAIN VAPOR BARRIER.
- COORDINATE ALL REMODEL WORK WITH NEW CONSTRUCTION AND OTHER TRADES.
- THE CONTRACTOR SHALL ADJUST AND BALANCE ALL MECHANICAL SYSTEMS TO DESIGN SETTINGS AS SHOWN AND SHALL REBALANCE TO RESTORE SETTINGS OF SYSTEMS TEMPORARILY ALTERED FOR THE PURPOSES OF COMPLETING THE WORK OF THIS PROJECT.
- NOTIFY AND COORDINATE WITH THE OWNER AT LEAST SEVEN DAYS PRIOR TO SHUTDOWN OF ANY BUILDING SERVICES OR EQUIPMENT. SHUTDOWN TIME SHALL BE KEPT TO A MINIMUM.
- ANY ITEMS DAMAGED DURING DEMOLITION SHALL BE REPLACED WITH NEW MATERIALS TO MATCH EXISTING.
- CONTRACTOR SHALL PROVIDE TEMPORARY DUCTWORK, ELECTRICAL SERVICE, PIPING OR OTHER BUILDING SERVICES AS REQUIRED TO KEEP OTHER AREAS IN OPERATION DURING REMODELING. NOTIFY OWNER PRIOR TO SHUT-DOWN FOR ANY TEMPORARY SERVICE REQUIREMENTS. ALL TEMPORARY WORK SHALL BE COMPLETELY REMOVED ONLY AFTER NEW SERVICES ARE COMPLETELY INSTALLED AND FUNCTIONAL.
- REFER TO ARCHITECTURAL REFLECTED CEILING PLANS FOR LOCATIONS OF CEILING-MOUNTED HVAC DEVICES AND EQUIPMENT.
- DUCT ROUTING CHANGES MADE BY THE CONTRACTOR FOR THE PURPOSE OF ACCOMMODATING FIELD CONDITIONS SHALL INCLUDE FIRE DAMPERS AND COMBINATION FIRE/SMOKE DAMPERS IN RATED PARTITIONS AS SHOWN IN ORIGINAL ROUTING ARRANGEMENTS.
- FURNISH AND INSTALL ACCESS DOORS (AD) IN THE DUCTWORK IMMEDIATELY ADJACENT TO EACH FIRE DAMPER AND EACH FIRE/SMOKE DAMPER. PARTITIONS SHALL BE PROVIDED WITH ACCESS DOORS TO PROVIDE SERVICE AND ACCESS TO DAMPER ACCESS DOORS.
- PROVIDE FIRE AND COMBINATION FIRE/SMOKE DAMPERS WHERE REQUIRED BY CODE. FIRE, SMOKE, AND COMBINATION FIRE/SMOKE DAMPERS SHALL BE UL LISTED, SHALL BEAR THE UL LABEL AND SHALL COMPLY WITH NFPA BULLETTIN NO. 90A. FULLY-OPENED DAMPERS SHALL NOT HAVE ANY PROJECTIONS INTO THE AIRSTREAM.
- ABANDONED DUCT SHALL BE REMOVED WHERE INDICATED ON THE DRAWINGS. DUCT REMAINING IN PLACE SHALL BE CAPPED, SEALED AIR TIGHT AT POINT(S) OF DEMOLITION, AND INSULATED TO MATCH EXISTING.
- NEW HOLES EXISTING FLOOR SHALL BE CORE DRILLED. ALL CORES SHALL BE X-RAYED PRIOR TO CORING.
- ALL DUCT SIZES SHOWN HEREIN REPRESENT INSIDE CLEAR DIMENSIONS. EXTERNAL SHEET METAL DIMENSIONS OF DUCTWORK THAT IS SPECIFIED TO BE INTERNALLY LINED SHALL BE ADJUSTED BY THE CONTRACTOR TO ALLOW FOR THICKNESS OF LINING.
- THE OWNER SHALL HAVE THE OPTION TO DESIGNATE ANY MATERIALS REMOVED OR DEMOLISHED DURING THIS WORK AS "RECYCLABLE" AND SHALL HAVE FINAL DISPOSITION OF THE DISPOSAL OF THESE MATERIALS. ALL MATERIALS REMOVED/DEMOLISHED BY THE CONTRACTOR FOR THIS JOB AND NOT RETAINED BY THE OWNER FOR RECYCLING OR OTHER PURPOSES SHALL BE DISPOSED OFF-SITE BY THE CONTRACTOR.
- THE OWNER SHALL HAVE FIRST RIGHT OF REFUSAL OF ANY EQUIPMENT DESIGNATED FOR REMOVAL. THE OWNER SHALL PROVIDE A LIST OF ITEMS THEY REQUIRE TO BE SALVAGED PRIOR TO THE START OF DEMOLITION. THE CONTRACTOR SHALL REMOVE THESE ITEMS USING REASONABLE CARE TO MINIMIZE DAMAGE.
- ANY AND ALL WATER CONNECTIONS MADE FOR THE PURPOSE OF CLEANING TOOLS OR THE WORK AREA OR FOR ANY OTHER CONSTRUCTION-RELATED PURPOSES SHALL NOT BE MADE ONLY TO DOMESTIC WATER HOSE BIBBS OR TO CONTRACTOR-SUPPLIED WATER SOURCES. APPROVED BACKFLOW PREVENTION DEVICES SHALL BE USED AS REQUIRED BY THE AUTHORITY HAVING JURISDICTION. CONNECTIONS SHALL NOT BE MADE TO FIRE WATER, CHILLED WATER, CONDENSER WATER, HEATING HOT WATER, DOMESTIC HOT WATER OR ANY OTHER TREATED WATER SOURCE UNLESS REQUIRED AS PART OF WORK ON THESE SYSTEMS.
- EXCEPT WHERE REQUIRED AT EQUIPMENT NOZZLES, FLANGES SHALL BE RAISED FACE WELD-NECK.
- INSTALL DIELECTRIC FITTINGS AT ALL FERROUS PIPE CONNECTIONS TO NON-FERROUS METALLIC PIPE OR EQUIPMENT.
- BULLHEAD TEES SHALL NOT BE USED TO JOIN CONVERGING (RETURN) FLOWS, REGARDLESS OF ARRANGEMENT SHOWN ON PLANS.
- PROVIDE ESCUTCHION PLATES WHERE PIPES EXPOSED TO VIEW PENETRATE FINISHED WALLS, FLOORS AND CEILINGS. SPLIT-RUN ESCUTCHION PLATES SHALL NOT BE USED UNO.
- PROVIDE CAPPED DRAIN VALVES AT LOW POINTS OF PIPING SYSTEMS AND AT EQUIPMENT CONNECTIONS. PROVIDE HOSE BIBB CONNECTIONS WITH CAPS AT DRAIN VALVES WHICH DO NOT DISCHARGE DIRECTLY OVER OR ARE NOT PIPED DIRECTLY TO AN APPROPRIATE DRAIN.
- PIPING, DUCTWORK OR EQUIPMENT CONNECTIONS OPENED BY DEMOLITION OR RENOVATION SHALL BE TEMPORARILY SEALED TO KEEP OUT FOREIGN MATERIAL UNTIL SUCH TIME AS RECONNECTIONS ARE MADE.

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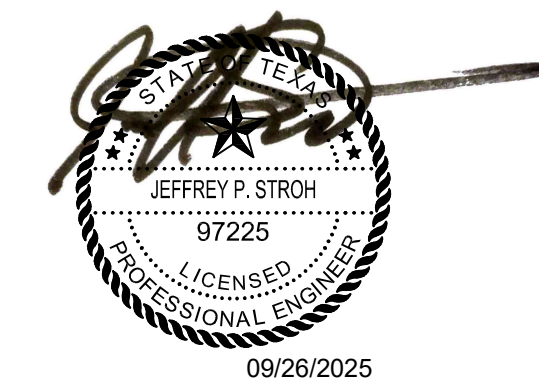
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-	09/26/2025	ISSUE FOR BID

PROJECT NAME
DALLAS COUNTY GEORGE
ALLEN COURTHOUSE HVAC
REPLACEMENT

PROJECT ADDRESS
600 COMMERCE ST.
DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

KEY PLAN

SHEET TITLE

MECHANICAL GENERAL
NOTES

SHEET NUMBER

M0.02

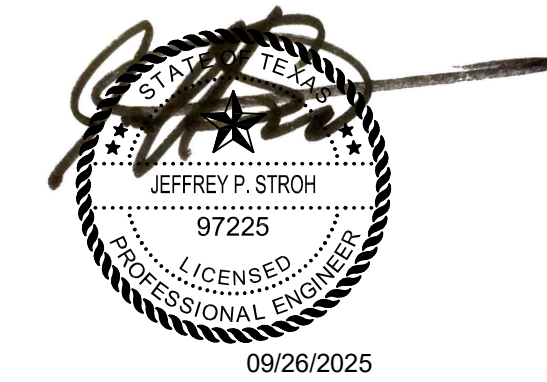
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MP OVERALL DEMOLITION FLOOR PLAN - LEVEL B1 | 1

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DALLAS COUNTY GEORGE ALLEN COURTHOUSE HVAC REPLACEMENT

PROJECT ADDRESS
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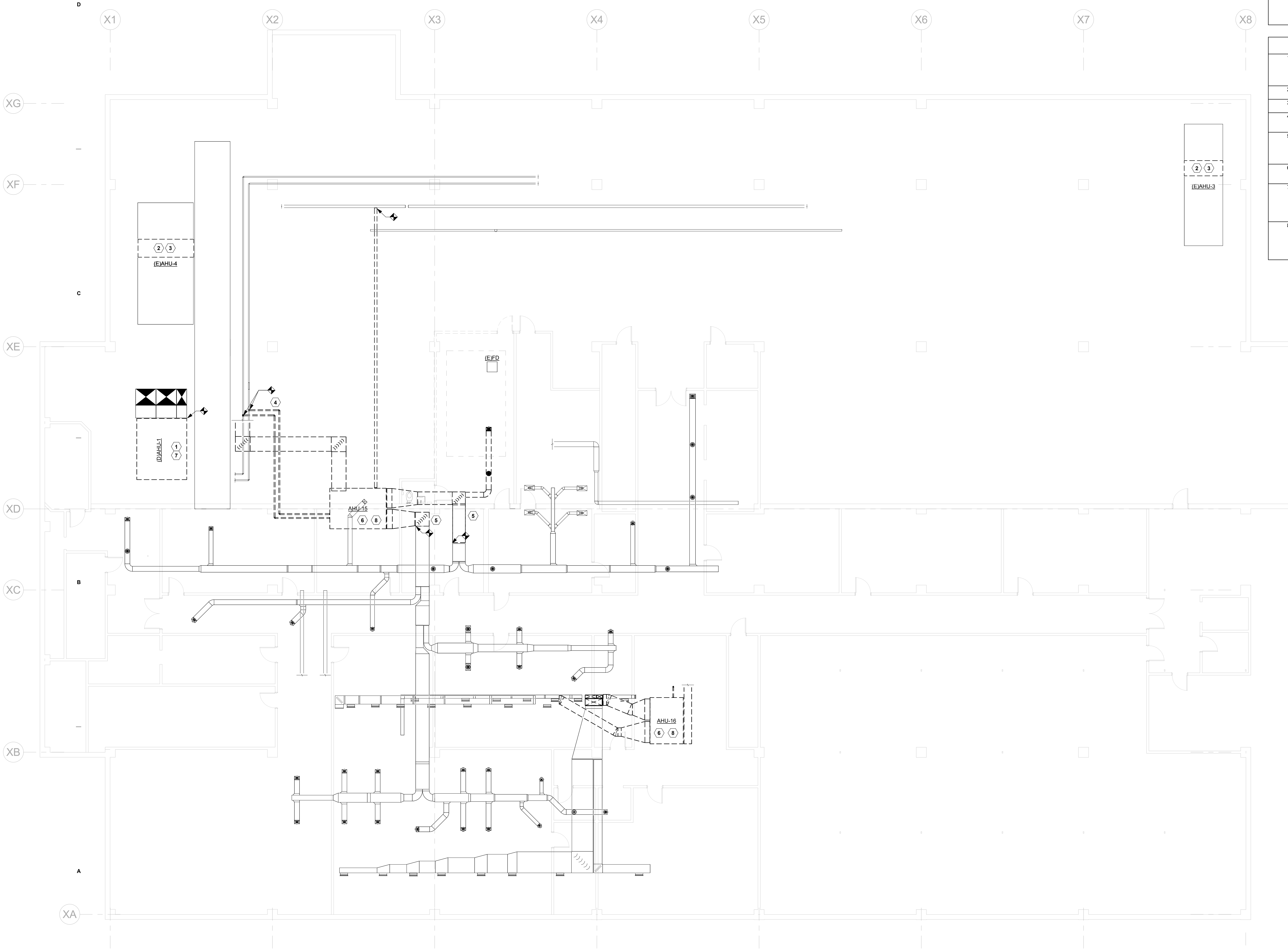
KIRKSEY PROJECT NO. 2024354
KEY PLAN

SHEET TITLE
MECHANICAL OVERALL DEMOLITION FLOOR PLAN - LEVEL B1

SHEET NUMBER
M2.11

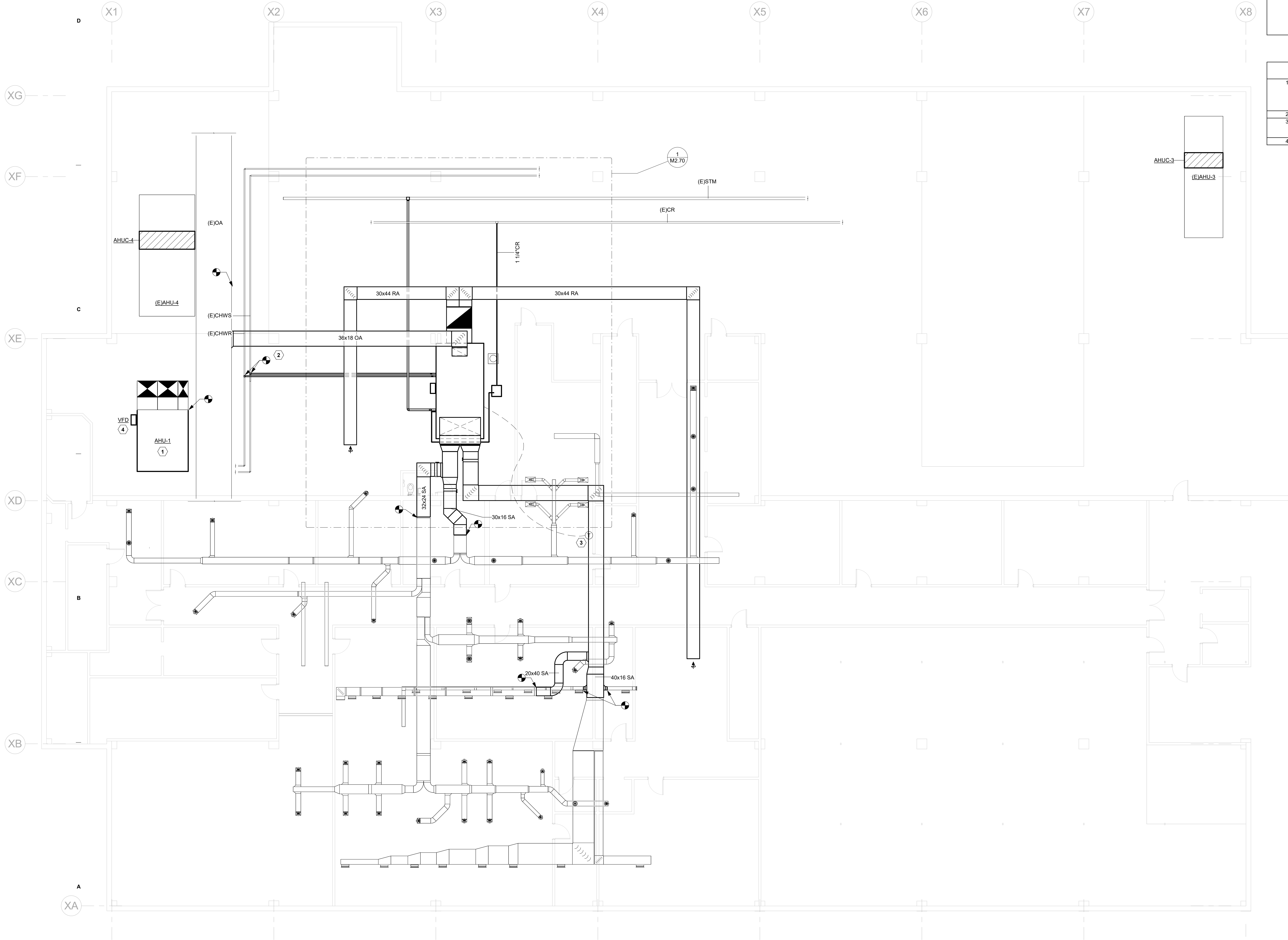
MECHANICAL DEMOLITION SHEET NOTES	
A	REFER TO SYMBOL LEGEND AND GENERAL NOTES FOR ADDITIONAL INFORMATION.
B	REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION.
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DEMOLITION KEYNOTES	
1	DEMOLISH EXISTING AHU AND ALL ASSOCIATED CONTROLS, VFD, THERMOSTAT, PIPING AND DUCTWORK NECESSARY FOR REMOVAL OF AHU. PROVIDE TEMPORARY CAPS ON SUPPLY, RETURN AND OUTSIDE AIR UNTIL NEW CONNECTION.
2	REMOVE EXISTING CHILLED WATER COIL FROM AHU. PROVIDE TEMPORARY CAP FOR NEW CONNECTION.
3	REMOVE EXISTING STEAM COIL FROM AHU. PROVIDE TEMPORARY CAP FOR NEW CONNECTION.
4	DEMOLISH EXISTING CHWSR PIPES BACK TO POINT OF DISCONNECTION SHOWN ON THE PLAN. SEAL PIPE AIRTIGHT, CAP AND PATCH TO MATCH EXISTING CONDITIONS.
5	DEMOLISH EXISTING DUCTWORK TO POINT INDICATED, INCLUDING BUT NOT LIMITED TO INSTALLATION HARDWARE, HANGERS, INSULATION, AND ACCESSORIES. PROVIDE TEMPORARY CAP ON OPEN ENDS TO PROTECT FROM DEBRIS. PREPARE FOR NEW CONNECTION.
6	DEMOLISH EXISTING AHU AND ALL ASSOCIATED CONTROLS, THERMOSTAT, VFD, PIPING BACK TO MAIN AND DUCTWORK NECESSARY FOR REMOVAL OF AHU.
7	PRIOR TO COMMENCEMENT OF WORK, CONTRACTOR SHALL REVIEW THE EXISTING CONTROLS ASSOCIATED WITH THE EXISTING AHU AND REPLICATE EQUIVALENT CONTROL SEQUENCES FOR THE NEW AHU-1, INCLUDING, BUT NOT LIMITED TO, TEMPERATURE SENSORS, SUPPLY AIR, CHILLED WATER, AND STEAM COIL ZONE CONTROL OPERATIONS.
8	PRIOR TO COMMENCEMENT OF WORK, CONTRACTOR SHALL REVIEW THE EXISTING CONTROLS ASSOCIATED WITH THE EXISTING AHU AND REPLICATE EQUIVALENT CONTROL SEQUENCES FOR THE NEW AHU-17, INCLUDING, BUT NOT LIMITED TO, TEMPERATURE SENSORS, SUPPLY AIR, CHILLED WATER, AND STEAM COIL ZONE CONTROL OPERATIONS.



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KEYNOTES	
1	INSTALL NEW AHU ON EXISTING CURB. EXTEND CURB AS REQUIRED FOR FIT. PROVIDE DUCTWORK TO RECONNECT INTO EXISTING MULTI-ZONE DAMPER SECTION. PROVIDE CHWS/R PIPING REQUIRED TO CONNECT INTO EXISTING MAINS.
2	EXTEND 2 1/2\"/>
3	CONTRACTOR TO REPLACE EXISTING THERMOSTAT AND CONTROL WIRING. INSTALL NEW THERMOSTAT IN THE SAME LOCATION.
4	MOUNT VFD ON AHU UNIT.



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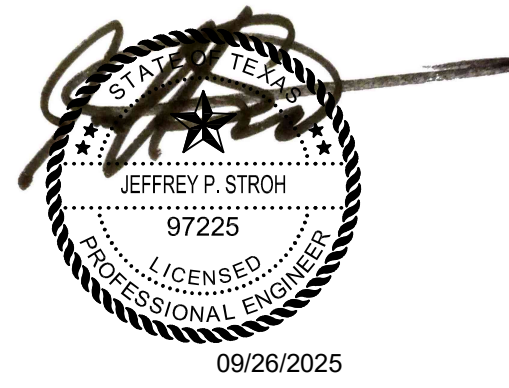
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PROJECT NAME
DALLAS COUNTY GEORGE ALLEN COURTHOUSE HVAC REPLACEMENT

PROJECT ADDRESS
600 COMMERCE ST.
DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

KEY PLAN

SHEET TITLE
MECHANICAL OVERALL FLOOR PLAN - LEVEL B1

SHEET NUMBER

M2.12

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MEP OVERALL FLOOR PLAN - LEVEL B1 | 1

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XB

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A

XC

XD

XE

XF

XG

A

XC

XD

XE

XF

XG

C

X1

X2

X3

X4

X5

X6

X7

X8

XG-9

XF-9

XE-9

XD-9

XC-9

A

SHEET TITLE

MECHANICAL OVERALL
DEMOLITION FLOOR PLAN -
LEVEL 9

SHEET NUMBER

M2.31

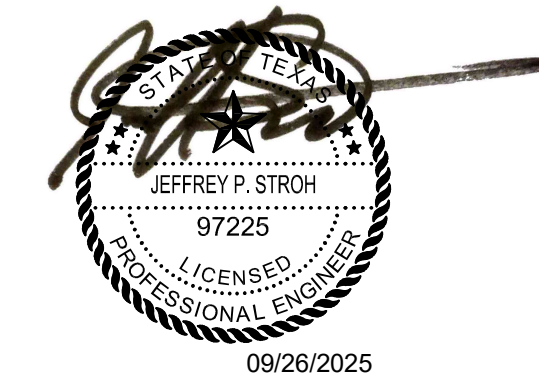
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PROJECT NAME
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ARCHITECTURE

MECHANICAL SHEET NOTES

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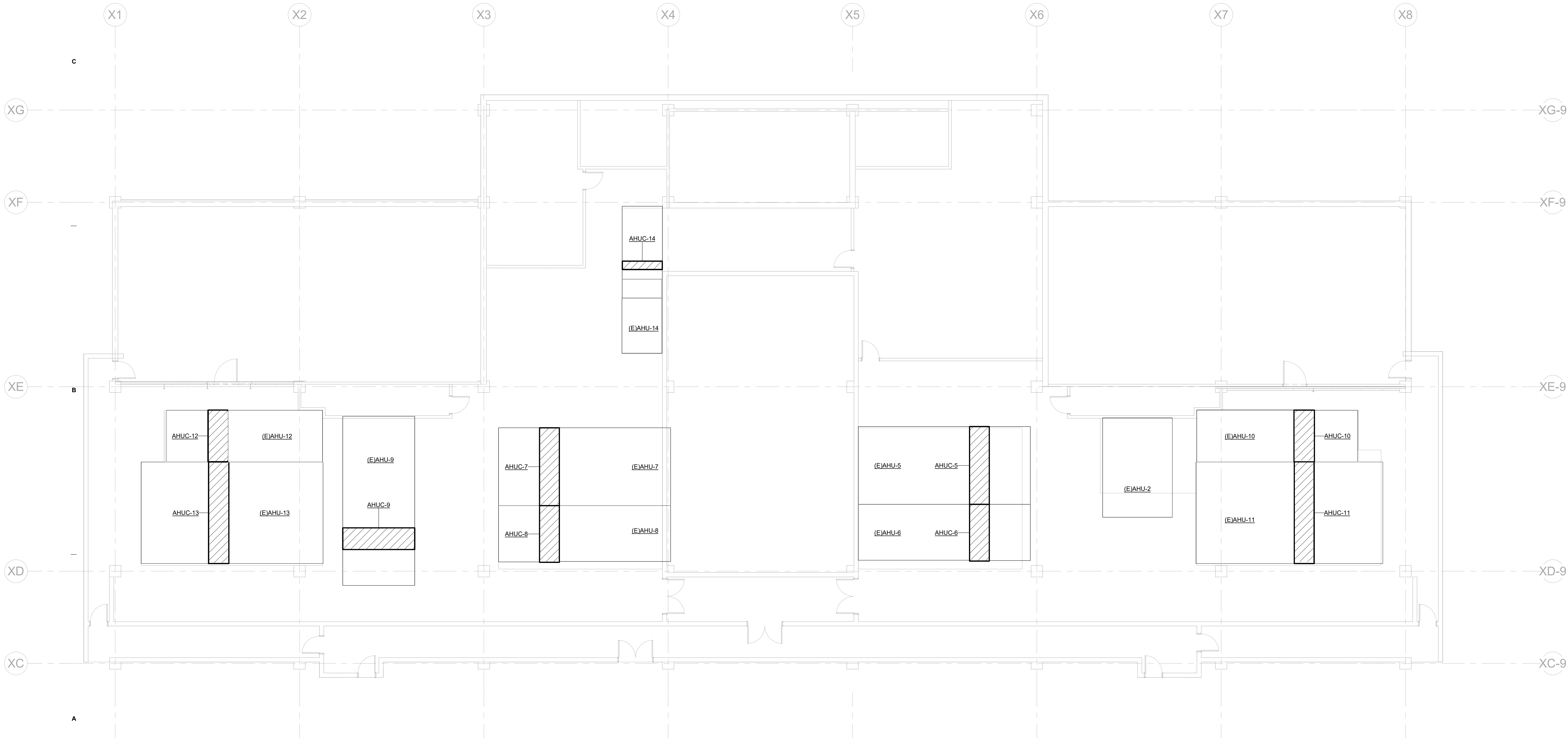
KEYNOTES

1	REMOVE EXISTING CHILLED WATER COIL FROM AHU. PROVIDE TEMPORARY CAP FOR NEW CONNECTION.
2	REMOVE EXISTING STEAM COIL FROM AHU. PROVIDE TEMPORARY CAP FOR NEW CONNECTION.

MECHANICAL OVERALL DEMOLITION FLOOR PLAN - LEVEL 9 | 1

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MECHANICAL OVERALL FLOOR PLAN - LEVEL 9 | 1

MECHANICAL SHEET NOTES	
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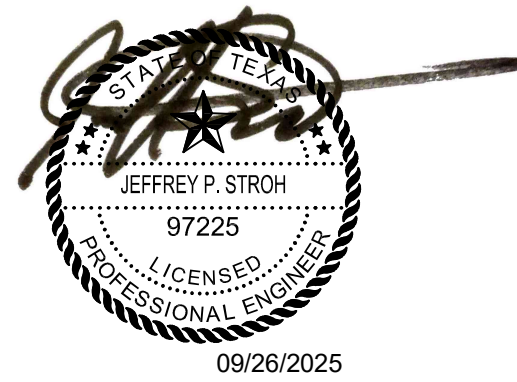
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PROJECT ADDRESS
600 COMMERCE ST.
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KIRKSEY PROJECT NO. 2024354

KEY PLAN

SHEET TITLE

MECHANICAL OVERALL FLOOR PLAN - LEVEL 9

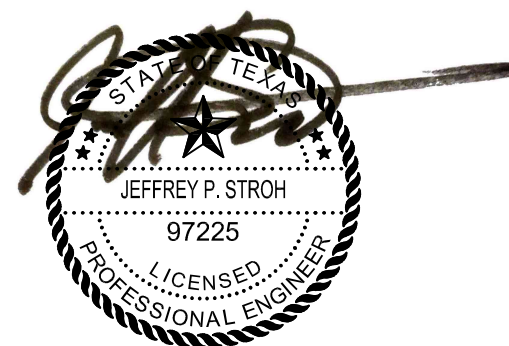
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C	09/29/2025	100% CONSTRUCTION DOCUMENTS
	09/29/2025	ISSUE FOR BID

PROJECT NAME
DALLAS COUNTY GEORGE
ALLEN COURTHOUSE HVAC
REPLACEMENT

PROJECT ADDRESS
600 COMMERCE ST.
DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354
KEY PLAN

SHEET TITLE
MECHANICAL ENLARGED
FLOOR PLAN - MECHANICAL
ROOM

SHEET NUMBER

M2.70

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PLUMBING SHEET NOTES

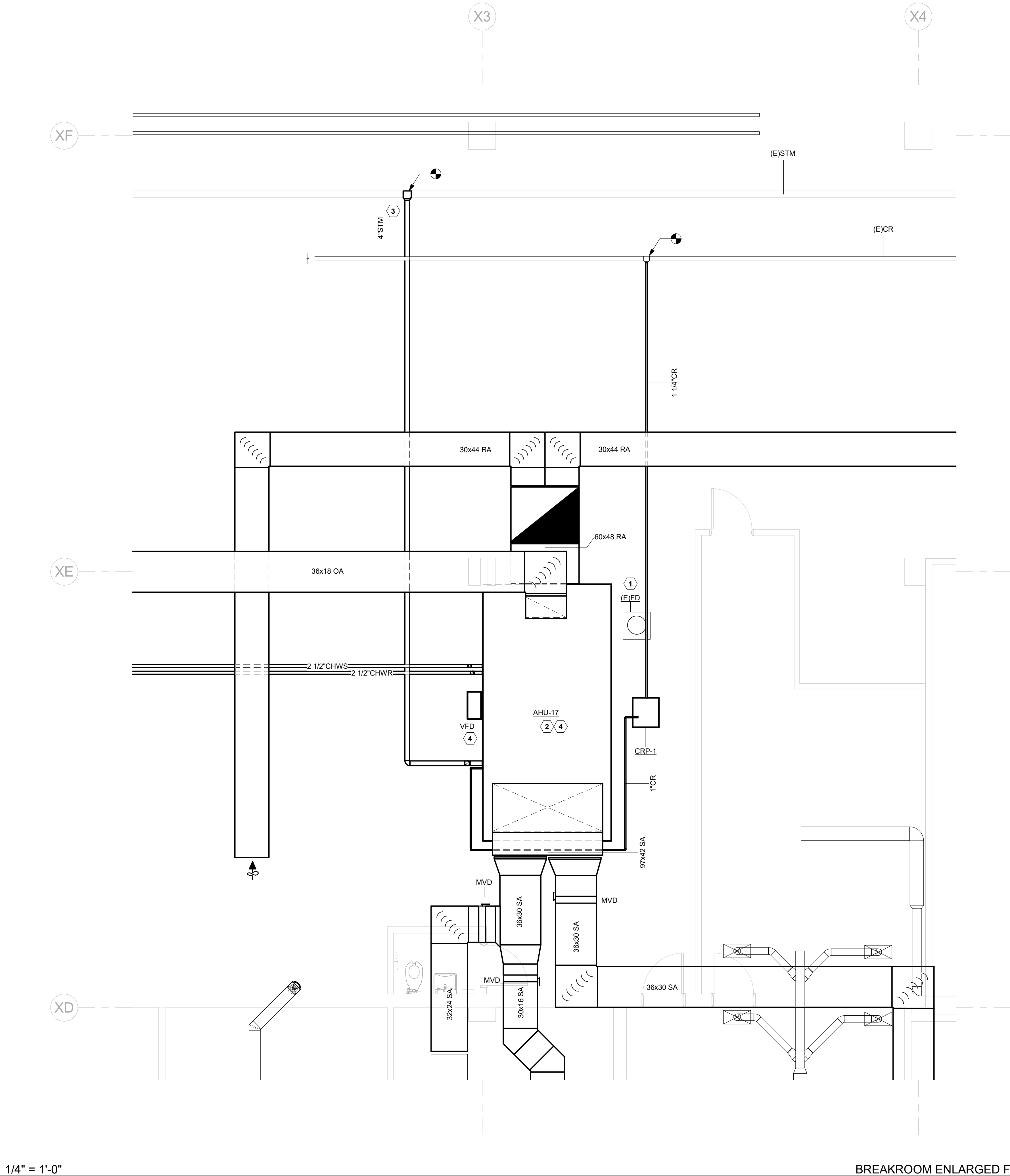
A	REFER TO SYMBOL LEGEND AND GENERAL NOTES FOR ADDITIONAL INFORMATION.
B	REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION.

MECHANICAL SHEET NOTES

A	REFER TO SYMBOL LEGEND AND GENERAL NOTES FOR ADDITIONAL INFORMATION.
B	REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION.
C	EXISTING HVAC SYSTEMS, DUCTWORK, PIPING, ETC. ARE APPROXIMATE SIZES AND LOCATIONS BASED ON LIMITED AS-BUILTS AND FIELD OBSERVATIONS. CONTRACTOR IS RESPONSIBLE TO VERIFY ALL DIMENSIONS, SIZES, LOCATIONS, AND CONDITIONS BEFORE BEGINNING WORK. THE CONTRACTOR SHALL NOTIFY THE ARCHITECT/ENGINEER OF RECORD IN WRITING OF ANY DISCREPANCIES, OMISSIONS, AND/OR CONFLICTS BEFORE COMMENCEMENT OF WORK INTENDED IN THESE CONTRACT DOCUMENTS. COMMENCEMENT OF WORK SHALL CONSTITUTE THE ACCEPTANCE OF COMPATIBILITY OF ALL NEW OR EXISTING CONDITIONS. CONTRACTOR IS RESPONSIBLE TO PERFORM ALL WORK IN ACCORDANCE WITH ALL APPLICABLE CODES, ORDINANCES, REGULATORY AGENCIES, AND STANDARD INDUSTRY TRADE PRACTICES.

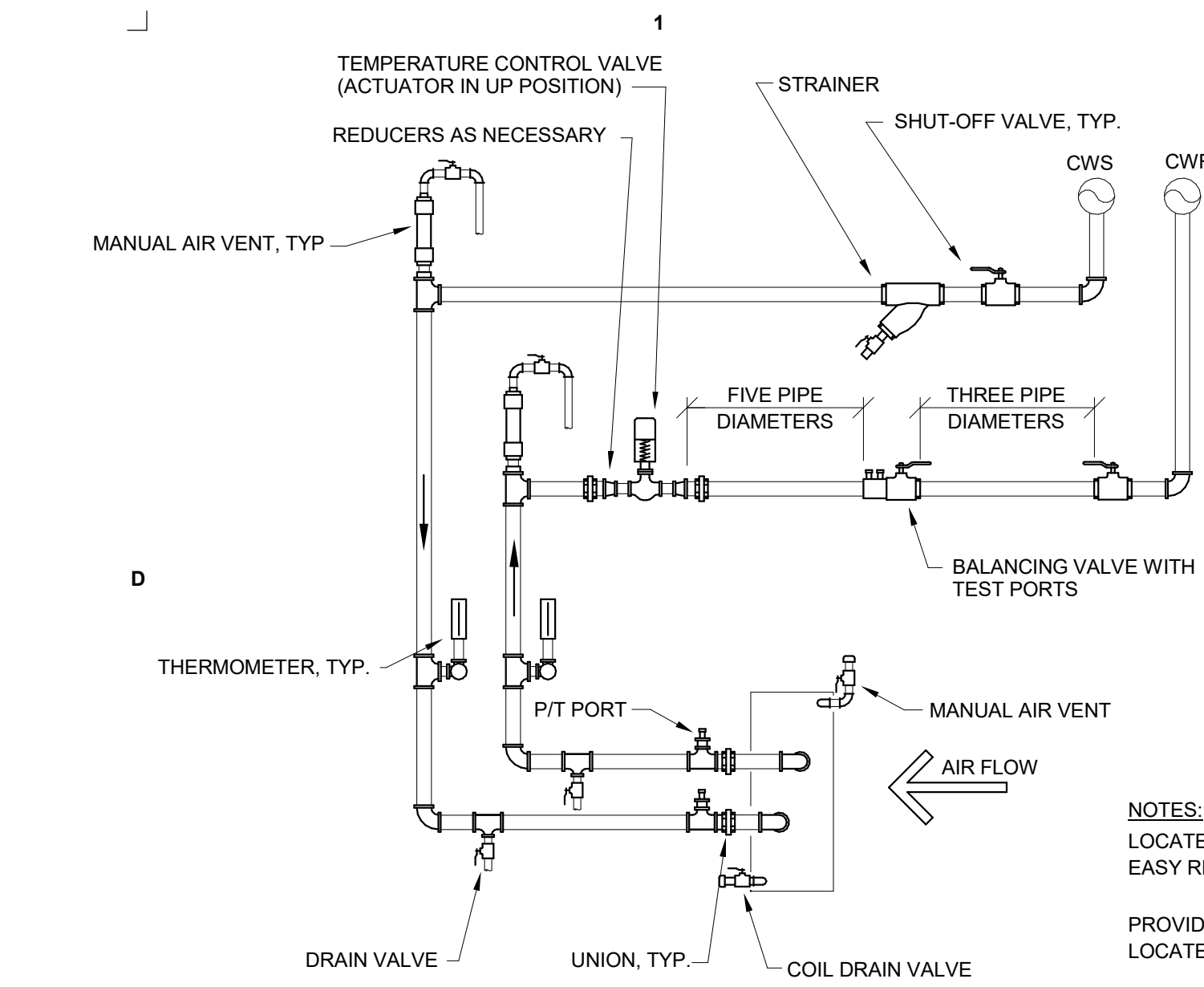
KEYNOTES

1	ROUTE 3/4" CONDENSATE FROM AHU UNIT TO BE DRAINED TO EXISTING FLOOR DRAIN. PROVIDE 1" AIR GAP MINIMUM REQUIRED BY CODE.
2	INSTALL NEW AHU ON NEW CURB. PROVIDE DUCTWORK AND CHWS/R PIPING REQUIRED TO CONNECT INTO EXISTING MAINS.
3	EXTEND STEAM PIPE AND CONNECT TO UNIT.
4	MOUNT VFD ON AHU UNIT.



1/4" = 1'-0"

BREAKROOM ENLARGED FLOOR PLAN | 1



DESIGNERS NOTES:

SHUT-OFF VALVES:
THROUGH 2-1/2" BALL VALVE
ABOVE 2-1/2" BUTTERFLY VALVE

BALANCING VALVES:
THROUGH 2-1/2" BALL VALVE
ABOVE 2-1/2" BUTTERFLY VALVE
WITH P/T TAPS AND MEMORY STOP

MANUAL AIR VENT:
BALL VALVE WITH HOSE END AND
CAP

DRAIN VALVE:
BALL VALVE WITH HOSE END AND
CAP

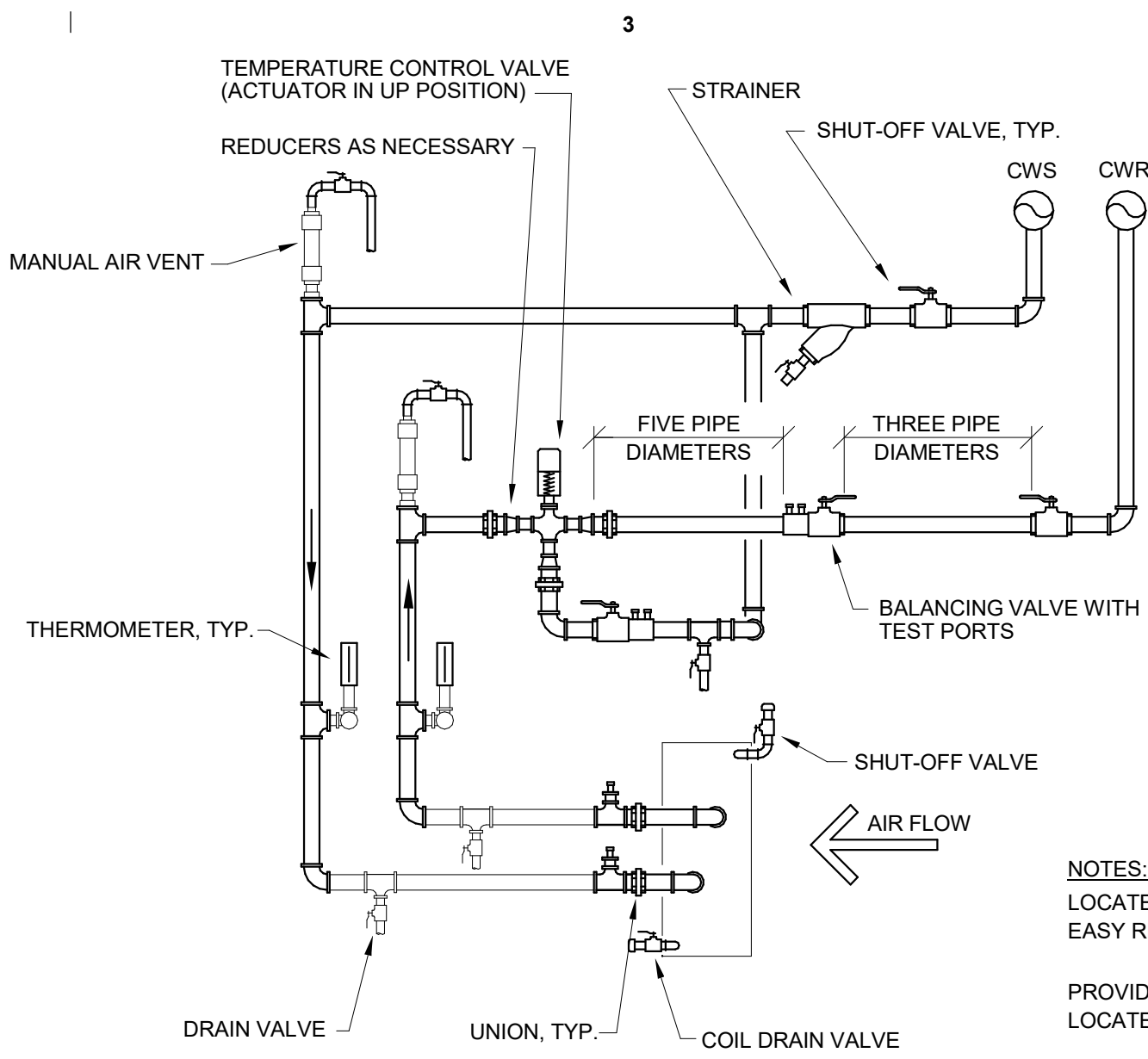
NOTES:
LOCATE UNIONS TO PROVIDE
EASY REMOVAL OF COILS

PROVIDE ALL DRAIN VALVES AND AIR VENTS
LOCATED INSIDE UNIT WITH HOSE END AND CAP

PIPE ALL DRAIN VALVES AND AIR VENTS
LOCATED OUTSIDE UNIT TO FLOOR DRAIN

COOLING COIL PIPING WITH TWO
WAY VALVE

SCALE: NONE



DESIGNERS NOTES:

SHUT-OFF VALVES:
THROUGH 2-1/2" BALL VALVE
ABOVE 2-1/2" BUTTERFLY VALVE

BALANCING VALVES:
THROUGH 2-1/2" BALL VALVE
ABOVE 2-1/2" BUTTERFLY VALVE
WITH P/T TAPS AND MEMORY STOP

MANUAL AIR VENT:
BALL VALVE WITH HOSE END AND
CAP

DRAIN VALVE:
BALL VALVE WITH HOSE END AND
CAP

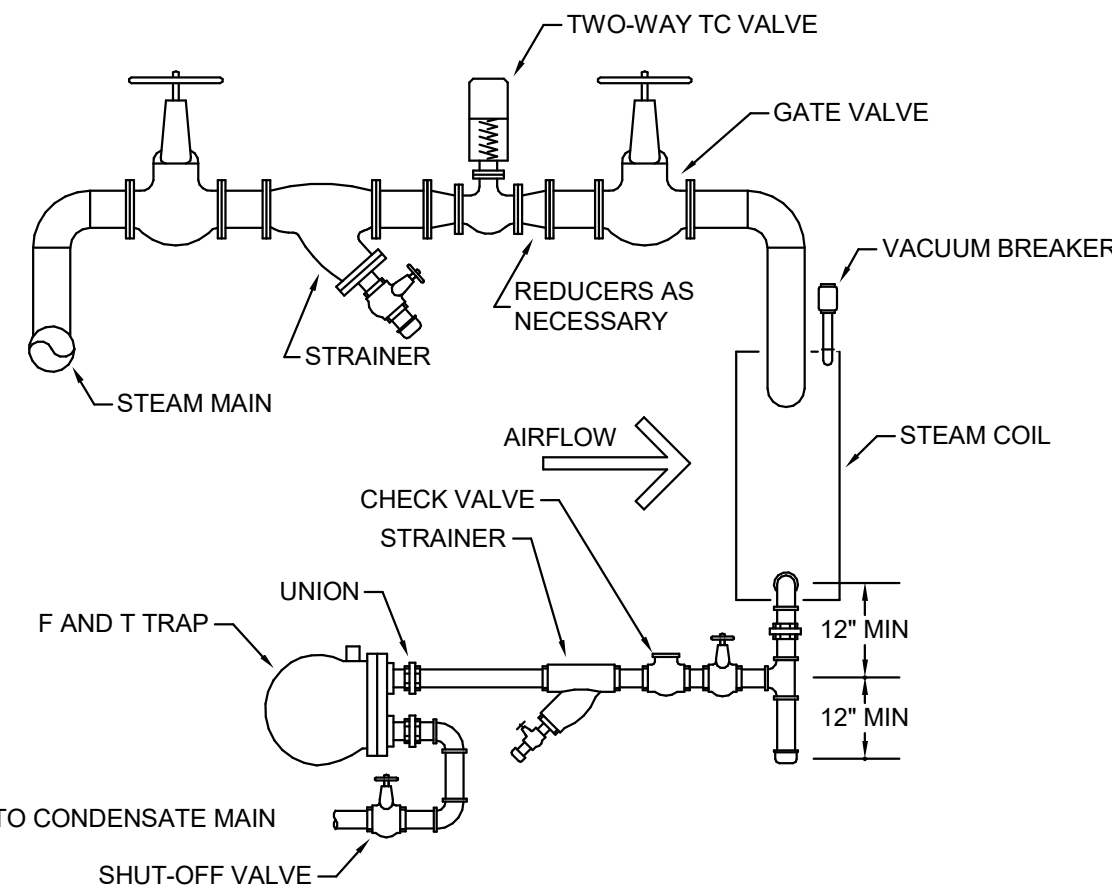
NOTES:
LOCATE UNIONS TO PROVIDE
EASY REMOVAL OF COILS

PROVIDE ALL DRAIN VALVES AND AIR VENTS
LOCATED INSIDE UNIT WITH HOSE END AND CAP

PIPE ALL DRAIN VALVES AND AIR VENTS
LOCATED OUTSIDE UNIT TO FLOOR DRAIN

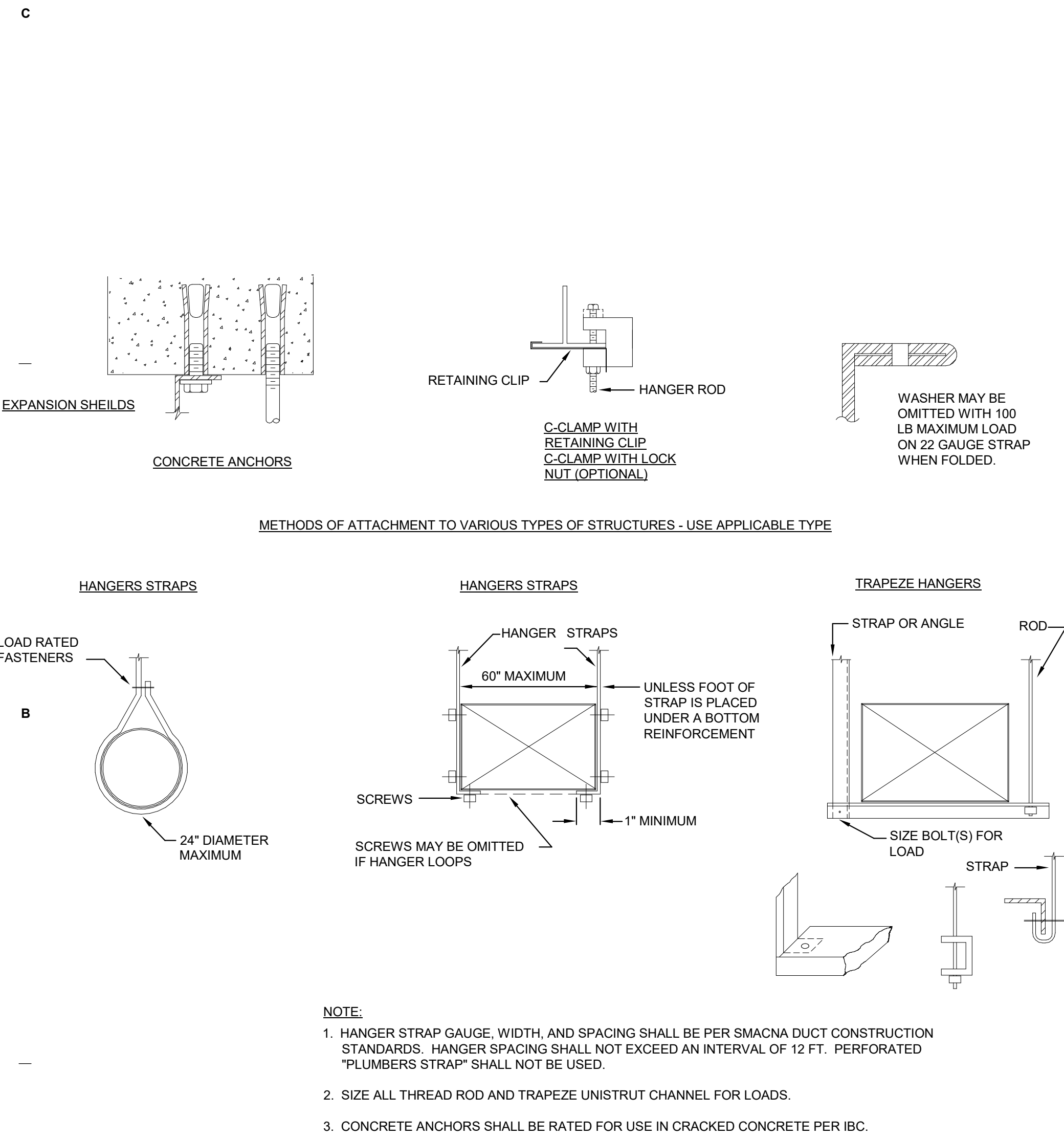
COOLING COIL PIPING WITH
THREE-WAY VALVE

SCALE: NONE



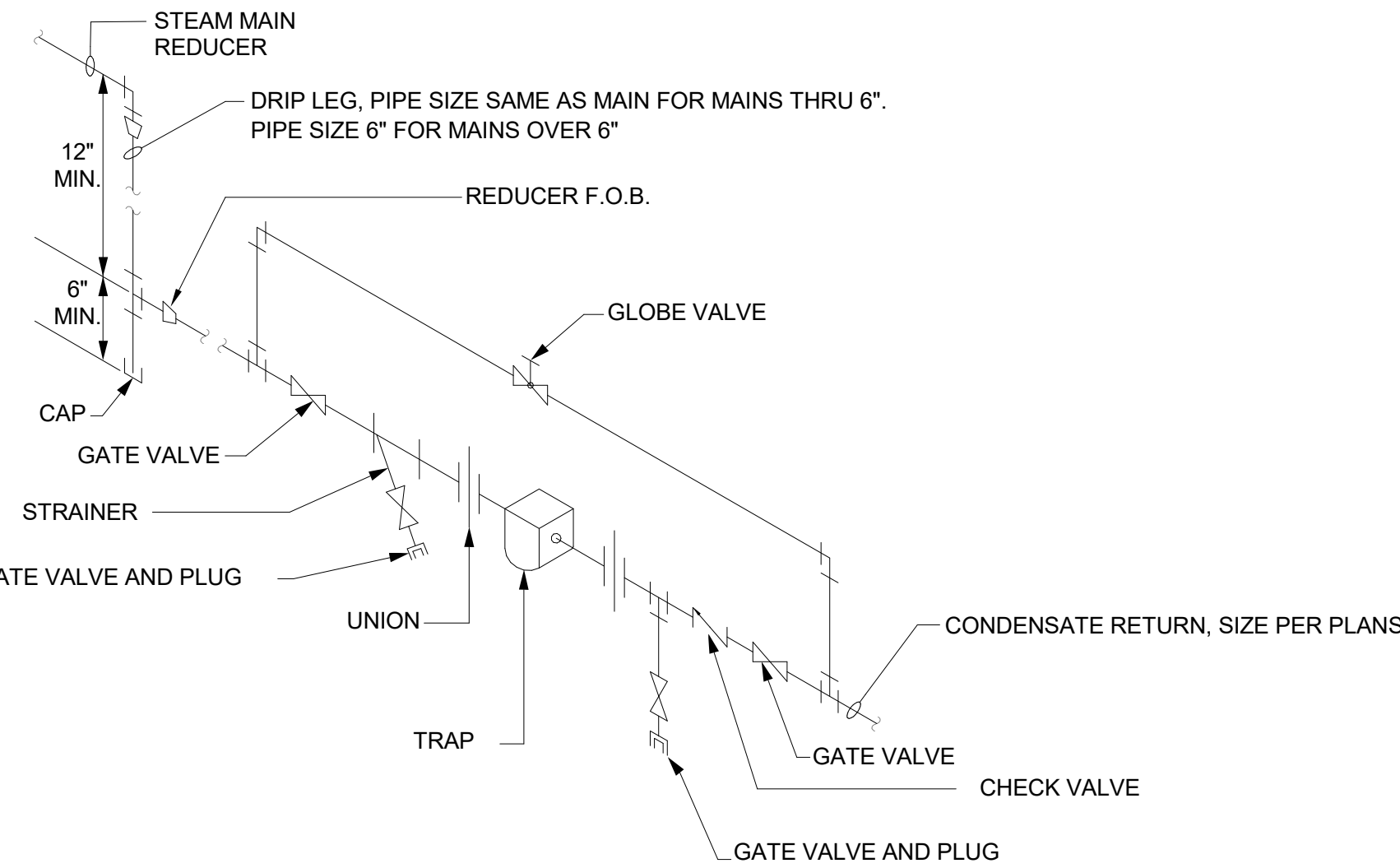
STEAM COIL PIPING DETAIL

SCALE: NONE



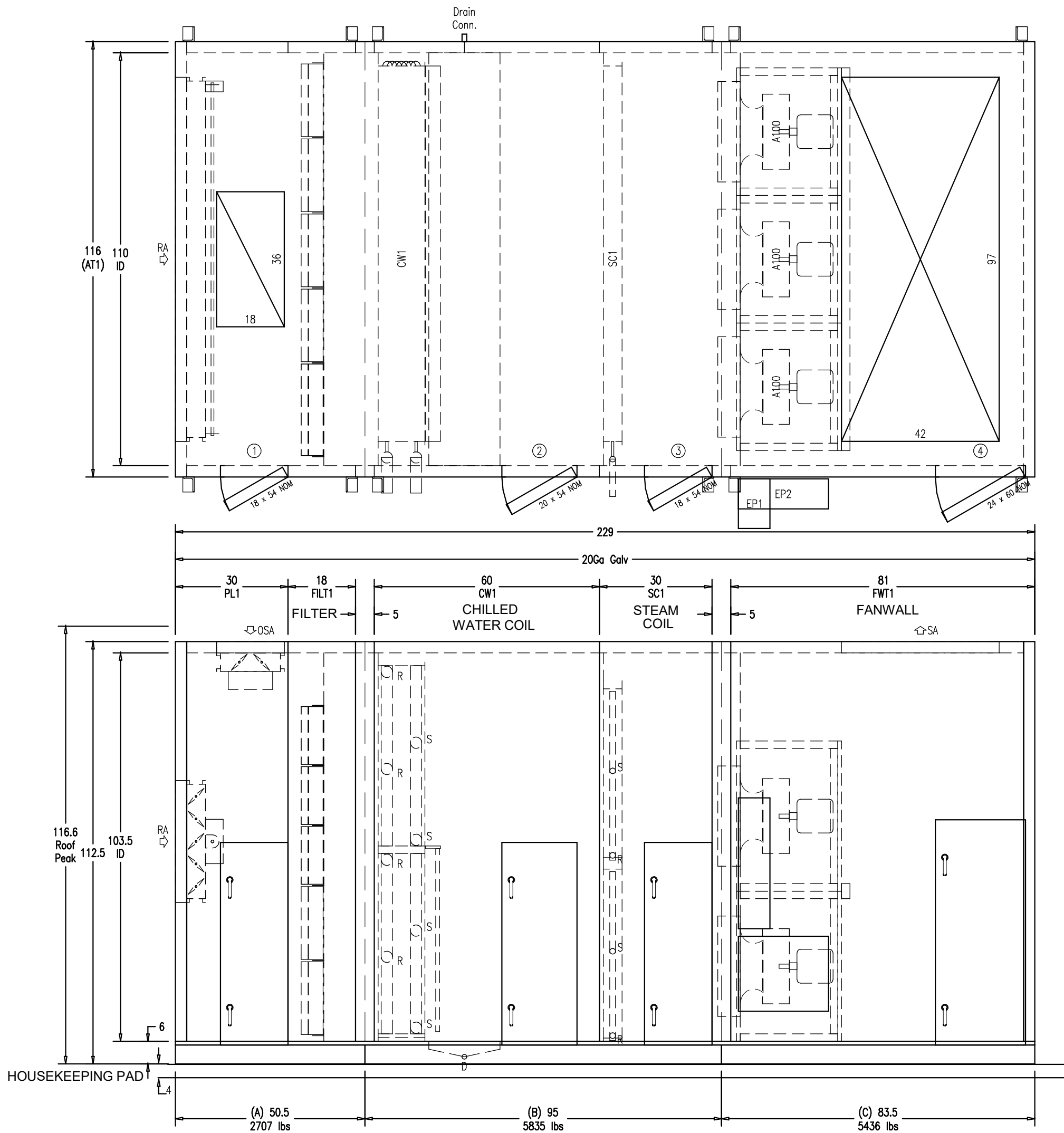
TYPICAL DUCT HANGER DETAIL

SCALE: NONE



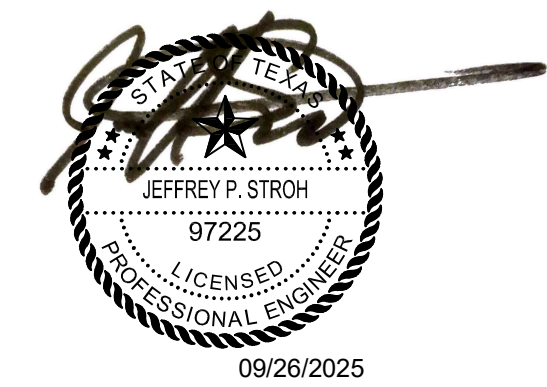
STEAM TRAP DETAIL

SCALE: NONE



AHU-17 DETAIL

SCALE: NONE



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DALLAS COUNTY GEORGE
ALLEN COURTHOUSE HVAC
REPLACEMENT

PROJECT ADDRESS
600 COMMERCE ST.
DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

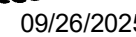
KEY PLAN

SHEET TITLE
MECHANICAL DETAILS

SHEET NUMBER

M8.01

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PROJECT ADDRESS
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KIRKSEY PROJECT NO. 2024354

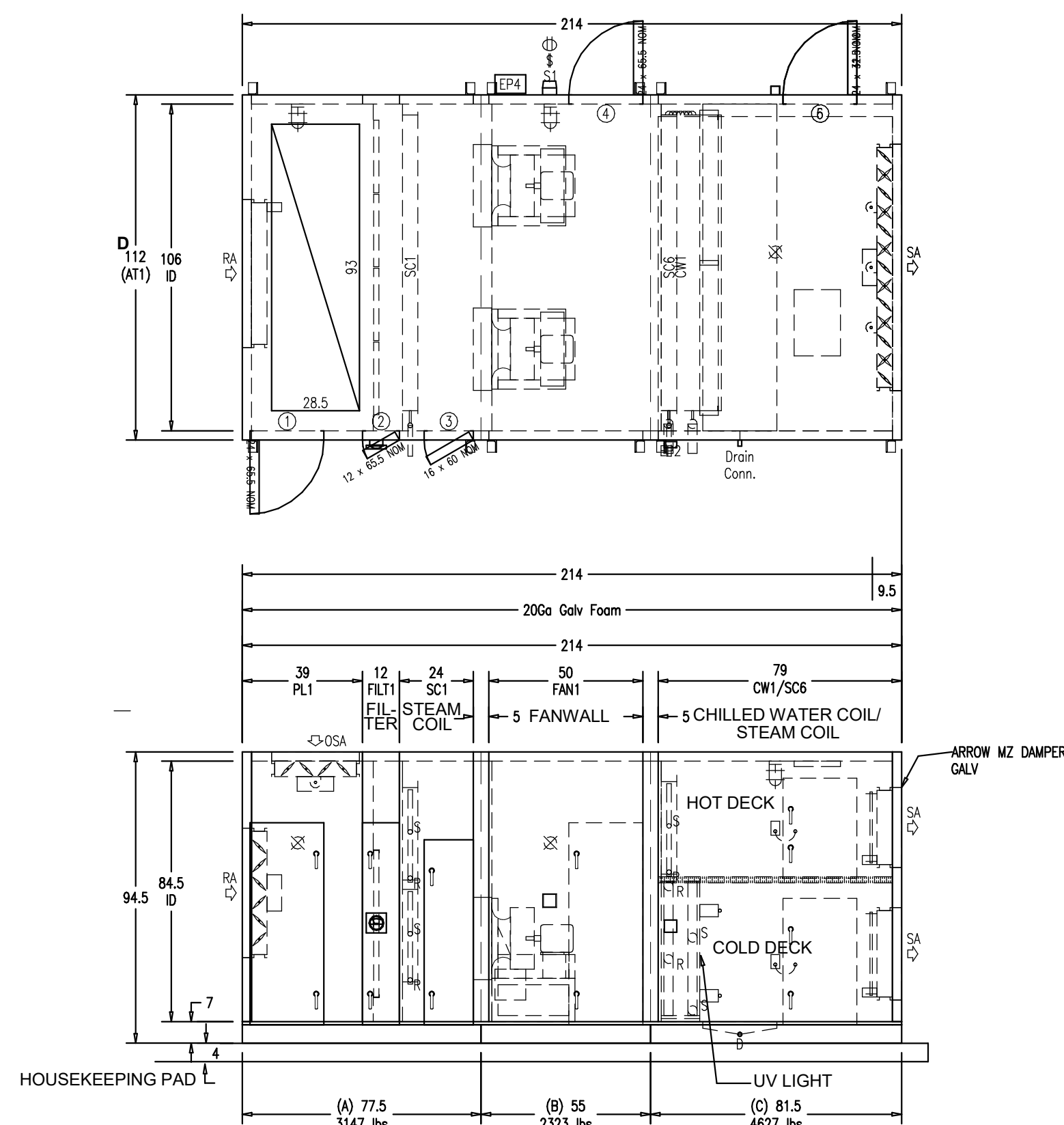
KEY PLAN

SHEET TITLE
MECHANICAL DETAILS

SHEET NUMBER

M8.02

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1 AHU-1 DETAIL
SCALE: NONE

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143 Manufacturing Street

Dallas Texas 75207

214 522 1100

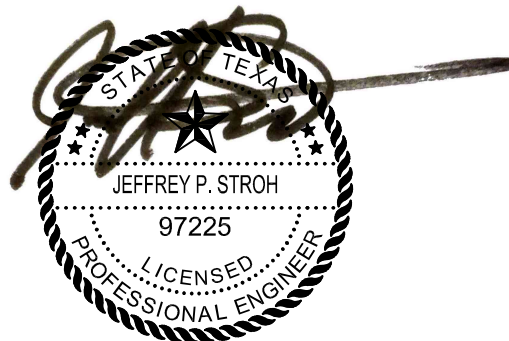
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(214) 696-6291
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Registration No: F-001731
Project Number: D25-3907.00

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600 COMMERCE ST.
DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354
KEY PLAN

SHEET TITLE
MECHANICAL SCHEDULES

SHEET NUMBER

M9.01

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HYDRONIC AIR HANDLING UNIT SCHEDULE																																			
MARK AHU-	ARRANGMENT	SUPPLY FAN							PRE-HEATING					STEAM HEATING					NET COOLING PERFORMANCE DATA										POWER CONN.				MANUFACTURER MAKE AND MODEL	REMARKS	
		SUPPLY CFM		O/A CFM		EXT. S.P.	QTY	HP	EAT	LAT	MBH	STEAM COIL		EAT	LAT	MBH	STEAM COIL		CAPACITY (MBH)			O.D. D.B.	E.A.T.		L.A.T. D.B.	WATER				V	PH	MCA			MOCP
		DES	MIN	DES	MIN							LBS/HR	PSI				LBS/HR	PSI	TOTAL	SENS.	LAT.		D.B.	W.B.		D.B.	E.W.T.	L.W.T.	GPM						
1	COLD DECK/ HOT DECK	15120	4540	13000	13000	3	2	12	24.0	71.7	855.0	890.0	5	55	83.9	487.9	507.7	5	1215	746	469	105	98	76	50	44	54	243	10	460	3	17	30	NORTEK/Temtrol Custom	ALL
17	UPFLOW	32000	9600	4000	4000	3	6	24	-	-	-	-	-	55	90.7	1274	1326	5	2489	1541	948	105	98	76	52	44	54	498	10	460	3	43	60	NORTEK/Temtrol Custom	ALL

- EXTERNAL STATIC PRESSURE ("WG") INCLUDES DUCTWORK, BALANCING DAMPERS AND AIR DEVICES ONLY.
- UNITS SHALL PERFORM TO LISTED CAPACITIES. UNIT PERFORMANCE MUST SATISFY BOTH SENSIBLE AND LATENT CAPACITY REQUIREMENTS.
- DESIGN BASIS IS TRANE. CONTRACTOR IS RESPONSIBLE FOR VARIATIONS IN FIT AND ELECTRICAL SERVICE.
- PROVIDE WITH TERMINAL STRIP FOR CONTROL SYSTEM INTERFACE - COORDINATE WITH CONTROLS CONTRACTOR.
- PROVIDE WITH 2" MERV-A 8 FILTERS.
- PROVIDE SUPPLY FAN WITH VARIABLE FREQUENCY DRIVE AND SHAFT GROUNDING.
- PROVIDE WITH SUPPLY AND RETURN AIR SMOKE DETECTOR INTERLOCKED TO SUPPLY FAN.
- PROVIDE WITH INTEGRAL DISCONNECT AND UNPOWERED GFCI RECEPTACLE.
- PROVIDE WITH STAINLESS STEEL OR CORROSION RESISTANT CONDENSATE DRAIN PAN.

CONDENSATE PUMP SCHEDULE														
MARK	LOCATION	SERVES	TYPE	GPM	TOTAL HEAD	PUMP EFF.	MOTOR DATA				MANUFACTURER MAKE AND MODEL	REMARKS		
							HP	RPM	V	PH				
CRP-1	MECH ROOM	AHU-17	CENTRIFUGAL	9	20	80	0.5	1760	120	1	Cleaver-Brooks CRSS 12 Duplex 200503C4AB-TEFC	ALL		

- PUMP SUBMITTED MUST MEET STATED PUMP EFFICIENCY AT CONDITIONS SPECIFIED
- PUMP MOTOR SHALL BE INVERTER DUTY RATED WITH SHAFT GROUNDING
- PROVIDE WITH TEFC MOTOR
- PROVIDE WITH ANSI CLASS 125 FLANGES

EXISTING HYDRONIC/STEAM AIR HANDLING COIL REPLACEMENT SCHEDULE																						
MARK AHUC-	ARRANGMENT	STEAM HEATING COIL DATA						CHILLED WATER COOLING COIL DATA												MANUFACTURER MAKE	REMARKS	
		COIL CFM	EAT	LAT	MBH	ROWS	COIL DIMMENSIONS	COIL CFM	CAPACITY (MBH)		E.A.T.		L.A.T.		WATER				ROWS			COIL DIMMENSIONS
									SENS.	TOTAL	D.B.	W.B.	D.B.	E.W.T	delta T	L.W.T.	GPM					
3	COLD DECK / HOT DECK	21000	74.0	112	861.8	1.0	4-0 W x 11-4 H	29700	978.3	1337	81.6	63.5	51.1	45.0	10	55	200	6	6-7 W x 11-4 H	NORTEK	-	
4	COLD DECK / HOT DECK	23000	69.0	82	322.9	1.0	3-0 W x 11-4 H	24000	909.8	1728	86.1	66.6	51.0	45.0	9	55	200	6	5-6 W x 11-4 H	NORTEK	-	
5	COLD DECK / HOT DECK	27000	70.0	82	349.9	1.0	4-0 W x 11-4 H	34600	1337.8	2024	86.3	67.2	50.5	45.0	7	52	380	6	8-0 W x 11-4 H	NORTEK	-	
6	COLD DECK / HOT DECK	20000	80.0	82	43.2	1.0	3-6 W x 11-4 H	24600	993.6	1439	87.9	66.1	50.5	45.0	9	55	215	6	6-0 W x 11-4 H	NORTEK	-	
7	COLD DECK / HOT DECK	27000	70.0	82	349.9	1.0	4-0 W x 11-4 H	34600	1337.8	2024	86.3	67	50.5	45.0	7	52	380	6	8-0 W x 11-4 H	NORTEK	-	
8	COLD DECK	-	-	-	-	-	-	24600	993.6	1439	87.9	66.1	50.5	45.0	9	55	215	6	6-0 W x 11-4 H	NORTEK	-	
9	COLD DECK / HOT DECK	21000	70.0	127	1292.8	1.0	10-0 W x 4-2 H	29730	1094.9	1739	84.6	65.5	50.5	45.0	9	55	255	6	10-0 W x 7-6 H	NORTEK	-	
10	COLD DECK	-	-	-	-	1.0	-	24650	681.5	1220	81.6	67.7	56.0	45.0	8	55	180	6	7-6 W x 9-0 H	NORTEK	-	
11	COLD DECK	-	-	-	-	-	-	33400	934.3	1804	84.4	69.2	58.5	45.0	8	55	240	4	15-0 W x 7-0 H	NORTEK	-	
12	COLD DECK	-	-	-	-	-	-	24650	681.5	1220	81.6	67.7	56.0	45.0	8	55	180	6	7-6 W x 9-0 H	NORTEK	-	
13	COLD DECK	-	-	-	-	-	-	33400	934.3	1804	84.4	69.2	58.5	45.0	8	55	240	4	15-0 W x 7-0 H	NORTEK	-	
14	COLD DECK / HOT DECK	18780	40.0	88	973.6	1.0	6-6 W x 9-0 H	-	-	-	-	-	-	-	-	-	-	-	-	NORTEK	1	

- WATER COILS TO HAVE A MINIMUM OF 8 FINS PER INCH. 8 ROWS DEEP. SELECT WATER COIL AT 43.5 ENT. WATER TEMP.

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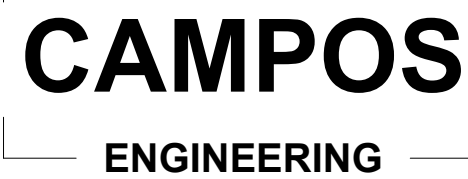
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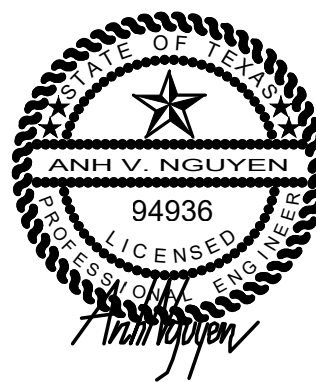
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PROJECT NAME
DALLAS COUNTY GEORGE
ALLEN COURTHOUSE HVAC
REPLACEMENT

PROJECT ADDRESS
600 COMMERCE ST.
DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

KEY PLAN

SHEET TITLE

**ELECTRICAL SYMBOL
LEGEND**

SHEET NUMBER

E0 01

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D

C

B

A

GENERAL POWER NOTES

- A. ALL ELECTRICAL WORK SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE AND ALL LOCAL, STATE CODES.
- B. ALL FLOOR CUTTINGS SHALL BE COORDINATED WITH STRUCTURAL DRAWINGS FOR RESTRICTIONS. COORDINATE WITH STRUCTURAL ENGINEER AND GENERAL CONTRACTOR.
- C. ELECTRICAL CONTRACTOR SHALL BE RESPONSIBLE TO MAINTAIN CODE REQUIRED MINIMUM CLEARANCES AROUND ELECTRICAL EQUIPMENT FOR WORKING SPACE, DEDICATED SPACE, ACCESSIBILITY FOR MAINTENANCE AND OPERATION.
- D. MECHANICAL EQUIPMENT WILL BE FURNISHED AND INSTALLED BY THE MECHANICAL CONTRACTOR. THE LOCATION SHOWN ON ELECTRICAL DRAWINGS ARE APPROXIMATE. REFER TO MECHANICAL DRAWINGS AND COORDINATE WITH MECHANICAL CONTRACTOR FOR EXACT LOCATION OF EACH PIECE OF EQUIPMENT AND DETERMINE EXACT ROUGH-IN AND CONNECTION REQUIREMENTS.
- E. ELECTRICAL CONTRACTOR SHALL MAKE ALL ELECTRICAL POWER CONNECTIONS TO HVAC, PLUMBING, KITCHEN AND OTHER EQUIPMENT AS REQUIRED.
- F. PROVIDE A TYPED DIRECTORY IN ALL PANELBOARDS CLEARLY DESCRIBING THE LOCATION OF AND TYPE OF LOAD BEING SERVED FOR ALL CIRCUITS. PROVIDE ENGRAVED PHENOLIC NAMEPLATES FOR ALL PANELBOARDS AND DISCONNECT SWITCHES.
- G. MINIMUM 20A BRANCH CIRCUIT SHALL BE 2#12, #12G, 3/4" C AND 2#10, #10G, 3/4" C FOR 30A BRANCH CIRCUIT. ALL CONDUCTORS SHALL BE COPPER, 75 DEGREE C, TYPE THHN/THWN EXCEPT WHERE OTHERWISE REQUIRED BY SPECIFICATION OR CODES.
- H. ALL 120V CIRCUITS LONGER THAN 70 FEET SHALL BE #10 AWG AND 277V CIRCUITS LONGER THAN 150 FEET SHALL BE #10 AWG UNLESS NOTED OTHERWISE.
- I. PROVIDE A PULLWIRE FOR ALL EMPTY CONDUITS.
- J. ALL EXTERIOR AND ROOF MOUNTED RECEPTACLES SHALL BE GFCI TYPE AND EQUIPPED WITH LISTED "EXTRA DUTY" WEATHERPROOF IN-USE COVER PER NEC.
- K. ALL ELECTRICAL EQUIPMENT SHALL BE RAINTIGHT (NEMA 3R) WHERE EXPOSED TO THE WEATHER. ALL FLEX CONDUITS CONNECTED TO SUCH EQUIPMENT SHALL BE LIQUIDTIGHT.
- L. ALL CIRCUITS SHALL BE PROVIDED WITH INDEPENDENT GROUND AND NEUTRAL WIRES. NO MULTIWIRE (SHARED NEUTRAL) BRANCH CIRCUITS SHALL BE PERMITTED.
- M. PROVIDE FIRE RETARDANT U.L. APPROVED SEALANT ON ALL PENETRATIONS, WALLS, AND STRUCTURAL SLABS. IT SHALL BE THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR TO SITE VERIFY PRIOR TO SUBMITTING BID, THE LOCATIONS OF ALL SUCH FIRE RATED PARTITIONS, WALLS AND STRUCTURAL SLABS.
- N. WHERE CORE DRILLING OF FLOORS/WALLS IS REQUIRED, THE CONTRACTOR SHALL SEAL OPENINGS WATERTIGHT AFTER UTILITIES HAVE BEEN INSTALLED. LOCATION OF CORED HOLES SHALL COORDINATE WITH LOCATION OF EQUIPMENT IN A MANNER THAT IS CLEAN AND FUNCTIONAL.
- O. ELECTRICAL CONTRACTOR TO PROVIDE CONDUIT, BACKBOX ROUGH-IN AND RELATED ELECTRICAL WORK FOR ALL PHONE/DATA, CARD READER, ELECTRIC DOOR STRIKE, PUSH-PLATES, HOLD OPEN DEVICES, ETC. REFER TO THE ARCHITECTURAL DRAWINGS, LOW VOLTAGE, SECURITY VENDOR'S DRAWINGS FOR EXACT DEVICE LOCATION. ALL LOW VOLTAGE WIRING SHALL BE BY LOW VOLTAGE CONTRACTOR.
- P. IT SHALL NOT BE THE INTENT OF THESE PLANS AND/OR SPECIFICATIONS TO SHOW EVERY MINOR DETAIL OF CONSTRUCTION. THE CONTRACTOR SHALL BE EXPECTED TO FURNISH AND INSTALL ALL ITEMS FOR A COMPLETE ELECTRICAL SYSTEM AND PROVIDE ALL REQUIREMENTS NECESSARY FOR EQUIPMENT TO BE PLACED IN PROPER WORKING ORDER. IT SHALL BE THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR TO PROVIDE ALL LABOR, MATERIALS AND SUPERVISION NECESSARY TO ACCOMPLISH THE WORK.
- Q. ELECTRICAL CONTRACTOR SHALL COORDINATE THEIR WORK WITH ALL OTHER CONTRACTORS AND TRADES BEFORE INSTALLATION OF THEIR WORK IN CHASES, CEILING SPACES AND OTHER AREAS WHERE CONFLICT MAY OCCUR.
- R. IN OTHER THAN ONE OR TWO-FAMILY DWELLING UNITS, PROVIDE LABELS OF AVAILABLE FAULT CURRENT WITH DATE CALCULATION ON ALL SWITCHGEAR, SWITCHBOARD, PANELBOARD ENCLOSURES PER NEC ARTICLES 110.24, 408.6.
- S. ARC-FLASH HAZARD WARNING LABELS SHALL BE PROVIDED AND APPLIED TO SWITCHBOARD, PANELBOARDS, MOTOR CONTROL CENTER, DISCONNECT SWITCHES AND EQUIPMENT CONTROLLERS PER NEC ARTICLE 110.16. THE LABEL SHALL BE PERMANENTLY AFFIXED TO THE EQUIPMENT AND SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED.

GENERAL DEMOLITION NOTES

- A. REFER TO ARCHITECTURAL DEMOLITION DRAWINGS FOR EXTENT OF DEMOLITION WORK.
- B. DEMOLITION DRAWINGS ARE BASED ON EXISTING PLANS AND FIELD INVESTIGATION PRIOR TO DEMOLITION. CONTACTOR SHALL VISIT THE SITE BEFORE BIDDING IN ORDER TO BECOME FAMILIAR WITH THE EXISTING CONDITIONS AND AVOID CONFLICTS. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES BETWEEN THE PLANS AND THE JOB SITE CONDITION AND TAKE THOSE DISCREPANCIES INTO ACCOUNT WHEN BIDDING OR SUBMIT BIDDING PROPOSAL.
- C. ELECTRICAL CONTRACTOR SHALL COORDINATE SERVICE INTERRUPTION WITH THE OWNER, ARCHITECT, UTILITY COMPANY AND SHALL NOT INTERRUPT POWER WITHOUT THE OWNER/ARCHITECT'S PERMISSION.
- D. LOCATE ALL EXISTING UTILITIES PRIOR TO STARTING THE WORK. PROTECT EXISTING UTILITIES FROM DAMAGE.
- E. WHERE REMOVED ITEM RESULTS IN DISCONTINUATION OF POWER TO DOWNSTREAM DEVICES, THE CONTRACTOR SHALL PROVIDE ALL NECESSARY REWIRING SO THAT THE EXISTING SYSTEM REMAINS IN GOOD OPERATION. RELOCATE EXISTING ELECTRICAL POWER OR LIGHTING EQUIPMENT OR SYSTEMS AS REQUIRED THAT INTERFERE WITH THEIR NEW WORK AND TO ACCOMMODATE THE WORK OF OTHER TRADES. ELECTRICAL DEVICES, LIGHTS, EQUIPMENTS AND SYSTEMS LOCATED IN AREAS OUTSIDE THE AREA OF WORK SHALL REMAIN IN SERVICE UNLESS OTHERWISE NOTED.
- F. ELECTRICAL CONTRACTOR SHALL IDENTIFY ALL CIRCUITS FREED BY DEMOLITION FOR RE-USE IN RENOVATED AREAS IF APPLICABLE.
- G. NEW CIRCUIT BREAKERS INSTALLED IN EXISTING PANELBOARDS SHALL BE OF THE SAME MANUFACTURER AND MATCH THE SHORT CIRCUIT RATING (AIC) AS THE PANELBOARD.
- H. ELECTRICAL CONTRACTOR SHALL UPDATE AS-BUILT DRAWINGS WITH THE EXACT CIRCUIT NUMBERS USED AND PROVIDE TYPEWRITTEN DIRECTORY CARD INSIDE PAPERBOARD REFLECTING THE CORRECTION INSTALLATION. ALL UNUSED EXISTING SPARE CIRCUITS SHALL BE IDENTIFIED. ALL SPARE BREAKERS SHALL BE TURN TO THE "OFF" POSITION AND LABEL "SPARE".
- I. COORDINATE WITH OWNER FOR DISPOSITION OF ALL REMOVED ELECTRICAL ITEMS. EXERCISE CARE IN REMOVAL OF DEMOLITION ITEMS, REPAIR AT NO ADDITIONAL COST TO THE OWNER, ANY DAMAGE CAUSED TO EXISTING CONSTRUCTION AND/OR EQUIPMENT TO REMAIN.



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Registration No: F-001731
Project Number: 025-3907-00

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B	08/14/2025	95% CONSTRUCTION DOCUMENTS
C	09/05/2025	100% CONSTRUCTION DOCUMENTS
-	09/22/2025	ISSUE FOR BID

PROJECT NAME
DALLAS COUNTY GEORGE
ALLEN COURTHOUSE HVAC
REPLACEMENT

PROJECT ADDRESS
600 COMMERCE ST.
DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

KEY PLAN

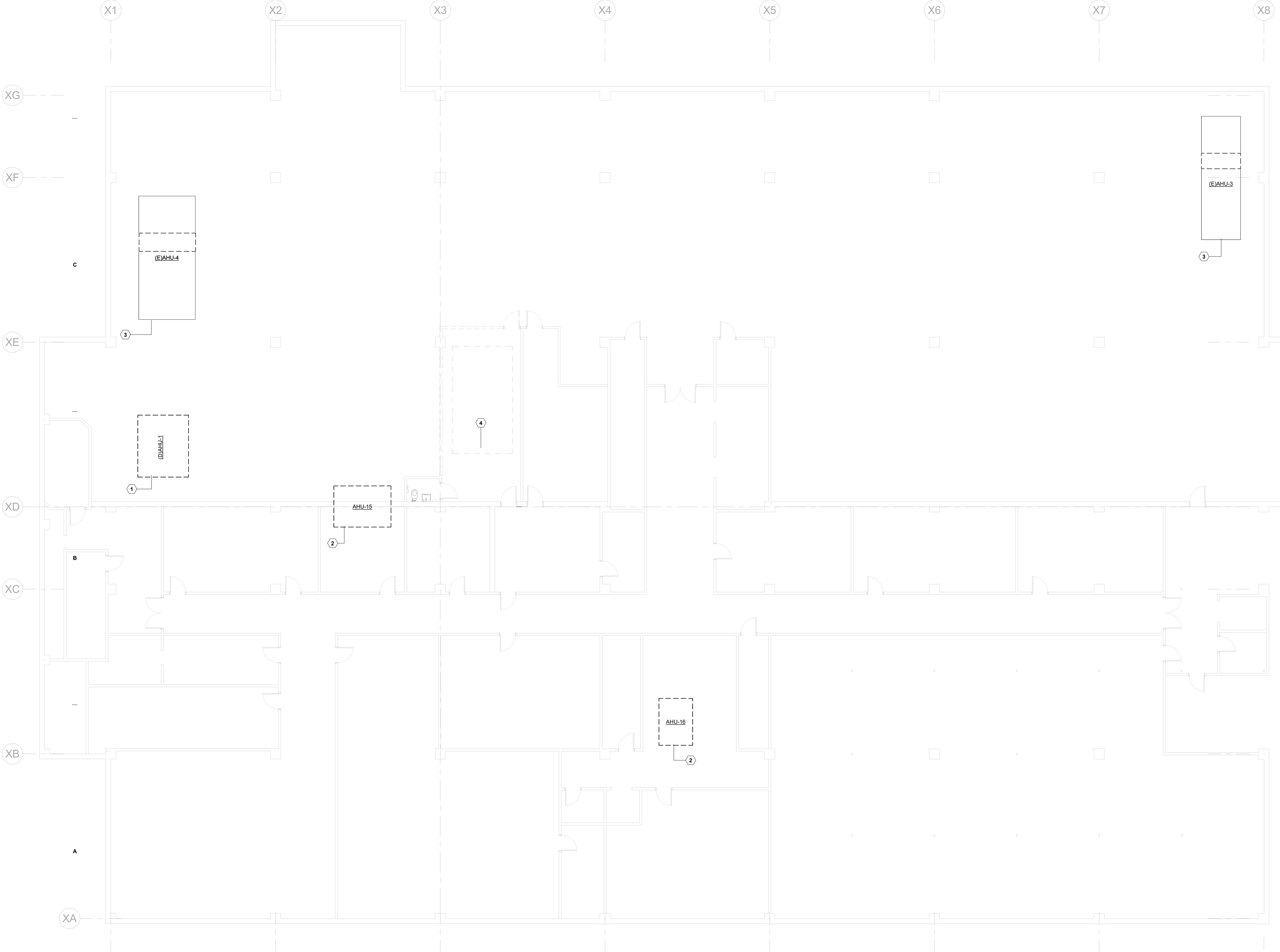
SHEET TITLE
ELECTRICAL GENERAL
NOTES

SHEET NUMBER

E0.02

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ELECTRICAL OVERALL DEMOLITION
FLOOR PLAN - LEVEL B1
1/8" = 1'-0"

POWER DEMOLITION SHEET NOTES	
A	REFER TO SYMBOL LEGEND AND GENERAL NOTES FOR ADDITIONAL INFORMATION.

DEMOLITION KEYNOTES	
1	ELECTRICAL CONTRACTOR SHALL MAINTAIN CIRCUIT FEEDERS AND CONDUITS PROVIDING POWER TO EXISTING AHU-1 AND RE-USE TO POWER NEW AHU AT THE SAME LOCATION. EXTEND CONDUIT AND WIRE AS REQUIRED. REFER TO SHEET E2.12 FOR ADDITIONAL INFORMATION.
2	ELECTRICAL CONTRACTOR SHALL REMOVE EXISTING CIRCUIT PROVIDING POWER TO EXISTING HVAC EQUIPMENT AND CONDUIT BACK TO THE POINT OF ORIGIN. CONTRACTOR SHALL THEN TURN OFF AND RE-LABEL BREAKER TO READ "SPARE" AND UPDATE ELECTRICAL INDEX CARD AS NECESSARY.
3	NO NEW ELECTRICAL WORK IS REQUIRED FOR EXISTING HVAC EQUIPMENT, UNLESS NOTED OTHERWISE.
4	REFER TO DRAWING E2.12 & M2.12 FOR INFORMATION ON NEW AIR HANDLING UNIT (AHU-17).

Kirksey
ARCHITECTURE

Dallas + Houston + Austin

143 Manufacturing Street

Dallas Texas 75207

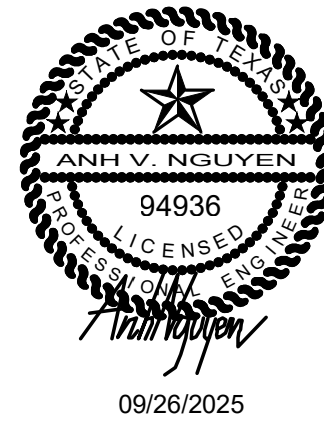
214 522 1100

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Registration No: F-001731
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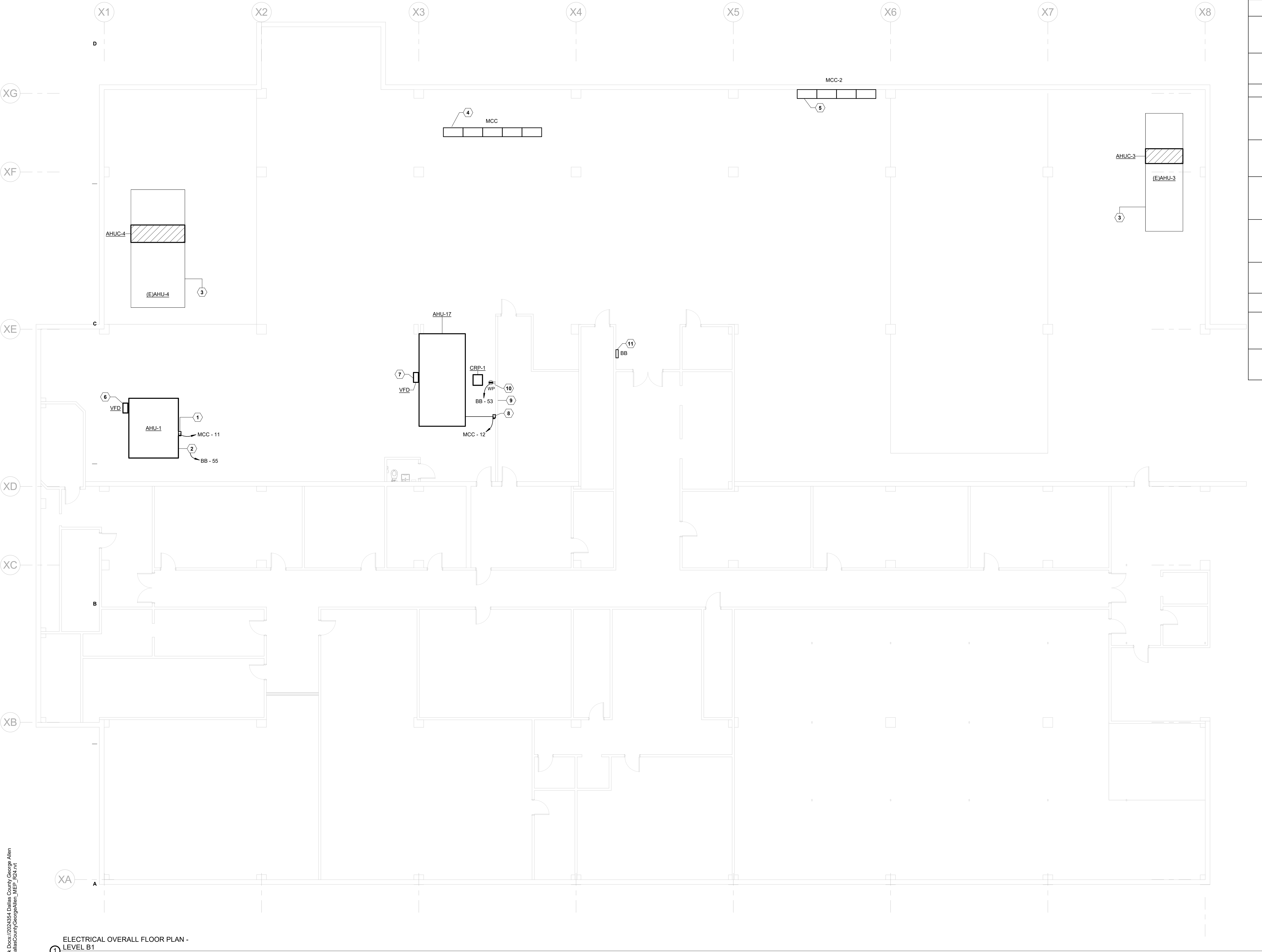
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ELECTRICAL OVERALL
DEMOLITION FLOOR PLAN -
LEVEL B1

SHEET NUMBER

E2.11

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ELECTRICAL OVERALL FLOOR PLAN -
LEVEL B1
1/8" = 1'-0"

POWER SHEET NOTES	
A	REFER TO SYMBOL LEGEND AND GENERAL NOTES FOR ADDITIONAL INFORMATION.
B	DRAWINGS ARE DIAGRAMMATIC; COORDINATE THE ROUGH-IN LOCATION, CONNECTION TYPE AND TERMINATION REQUIREMENTS WITH EQUIPMENT INSTALLERS PRIOR TO ROUGH-IN.
C	COORDINATE WITH THE OWNER FOR ALL REQUIRED POWER OUTAGE TO THE EXISTING ELECTRICAL EQUIPMENT PRIOR TO STARTING ANY NEW WORK.

KEYNOTES	
1	PROVIDE NEW 480V, 3 PHASE, 60A WEATHERPROOF FUSED DISCONNECT FOR NEW AHU-1. COORDINATE WITH MECHANICAL CONTRACTOR FOR EXACT LOCATION AND POWER REQUIREMENTS. SEE SHEET E3.01 FOR ADDITIONAL INFORMATION REGARDING THE DISCONNECT SIZE AND NEMA ENCLOSURE.
2	CONTRACTOR SHALL PROVIDE 120V/1PH CIRCUIT FOR SUPPLEMENTAL POWER FOR LIGHTING, RECEPTACLE OUTLETS, UV LIGHTS AND ACTUATORS. COORDINATE WITH MECHANICAL CONTRACTOR FOR EXACT SINGLE POINT OF CONNECTION AND EXACT POWER REQUIREMENTS.
3	NO NEW ELECTRICAL WORK IS REQUIRED FOR EXISTING HVAC EQUIPMENT, UNLESS NOTED OTHERWISE.
4	EXISTING MOTOR CONTROL CENTER 'MCC-2' LOCATED IN THIS APPROXIMATE LOCATION. CONTRACTOR TO USE THE REMAINING AVAILABLE SPACES TO POWER THE NEW MECHANICAL UNITS 'AHU-1' AND 'AHU-17'. CONDUIT AND FEEDERS FOR THE EXISTING 'AHU-1' SHALL REMAIN DURING RENOVATION TO PROVIDE ELECTRICAL POWER TO THE NEW 'AHU-1' UNIT THAT WILL REPLACE IT.
5	EXISTING MOTOR CONTROL CENTER 'MCC-2' LOCATED IN THIS APPROXIMATE LOCATION. EQUIPMENT SHOWN HERE FOR REFERENCE ONLY. DISCONNECT ELECTRICAL POWER FOR 'AHU-16' AND DEMOLISH ALL CONDUITS AND FEEDERS BACK TO THE SOURCE, AND THE UNUSED CIRCUIT SHALL BE LABELED AS 'SPARE' AND TURNED TO THE 'OFF' POSITION.
6	ELECTRICAL POWER FOR VFD FOR 'AHU-1', PROVIDED BY THE MECHANICAL CONTRACTOR, LOCATED HERE. ELECTRICAL CONTRACTOR TO USE THE EXISTING CONDUIT AND FEEDERS TO POWER THIS EQUIPMENT. COORDINATE EXACT LOCATION AND REQUIREMENTS IN THE FIELD. SEE MECHANICAL SCHEDULES AND CUTSHEETS FOR ADDITIONAL INFORMATION AND REQUIREMENTS.
7	ELECTRICAL POWER FOR VFD FOR 'AHU-17', PROVIDED BY THE MECHANICAL CONTRACTOR, LOCATED HERE. CONTRACTOR TO PROVIDE NEW CONDUIT AND FEEDERS TO POWER THIS EQUIPMENT. COORDINATE EXACT LOCATION AND REQUIREMENTS IN THE FIELD. SEE ELECTRICAL PANEL SCHEDULES AND MECHANICAL SCHEDULES AND CUTSHEETS FOR ADDITIONAL INFORMATION AND REQUIREMENTS.
8	PROVIDE NEW 480V, 3 PHASE, 60A FUSED DISCONNECT FOR NEW AHU-17. COORDINATE WITH MECHANICAL CONTRACTOR FOR EXACT LOCATION AND POWER REQUIREMENTS. SEE SHEET E3.01 FOR ADDITIONAL INFORMATION REGARDING THE DISCONNECT SIZE AND NEMA ENCLOSURE.
9	CONTRACTOR SHALL MAINTAIN EXISTING ELECTRICAL RECEPTACLES LOCATED ON THIS WALL AND UTILIZE THEM AS MAINTENANCE OUTLETS FOR AHU-17.
10	ELECTRICAL POWER FOR CONDENSATE RETURN PUMP CRP-1 LOCATED HERE. PROVIDE 120V POWER TO THE RECEPTACLE SERVING THIS EQUIPMENT. COORDINATE EXACT LOCATION AND REQUIREMENTS IN THE FIELD. SEE MECHANICAL SCHEDULES AND EQUIPMENT CUTSHEETS FOR ADDITIONAL REQUIREMENTS.
11	EXISTING PANEL 'BB' SHOWN HERE FOR REFERENCE ONLY. SEE ELECTRICAL PANEL SCHEDULE SHEET FOR ADDITIONAL INFORMATION REGARDING THE CIRCUITING INFORMATION FOR THE NEW CONDENSATE RETURN PUMP (CRP-1) THAT SHALL BE POWERED BY THIS PANEL.

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ALLEN COURTHOUSE HVAC
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DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

KEY PLAN

SHEET TITLE
ELECTRICAL OVERALL
FLOOR PLAN - LEVEL B1

SHEET NUMBER

E2.12

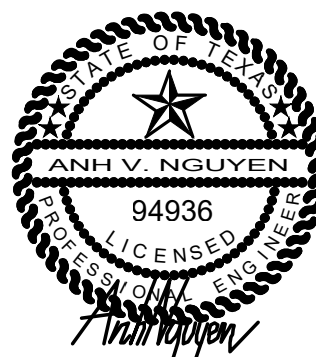
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DALLAS, TX 75202

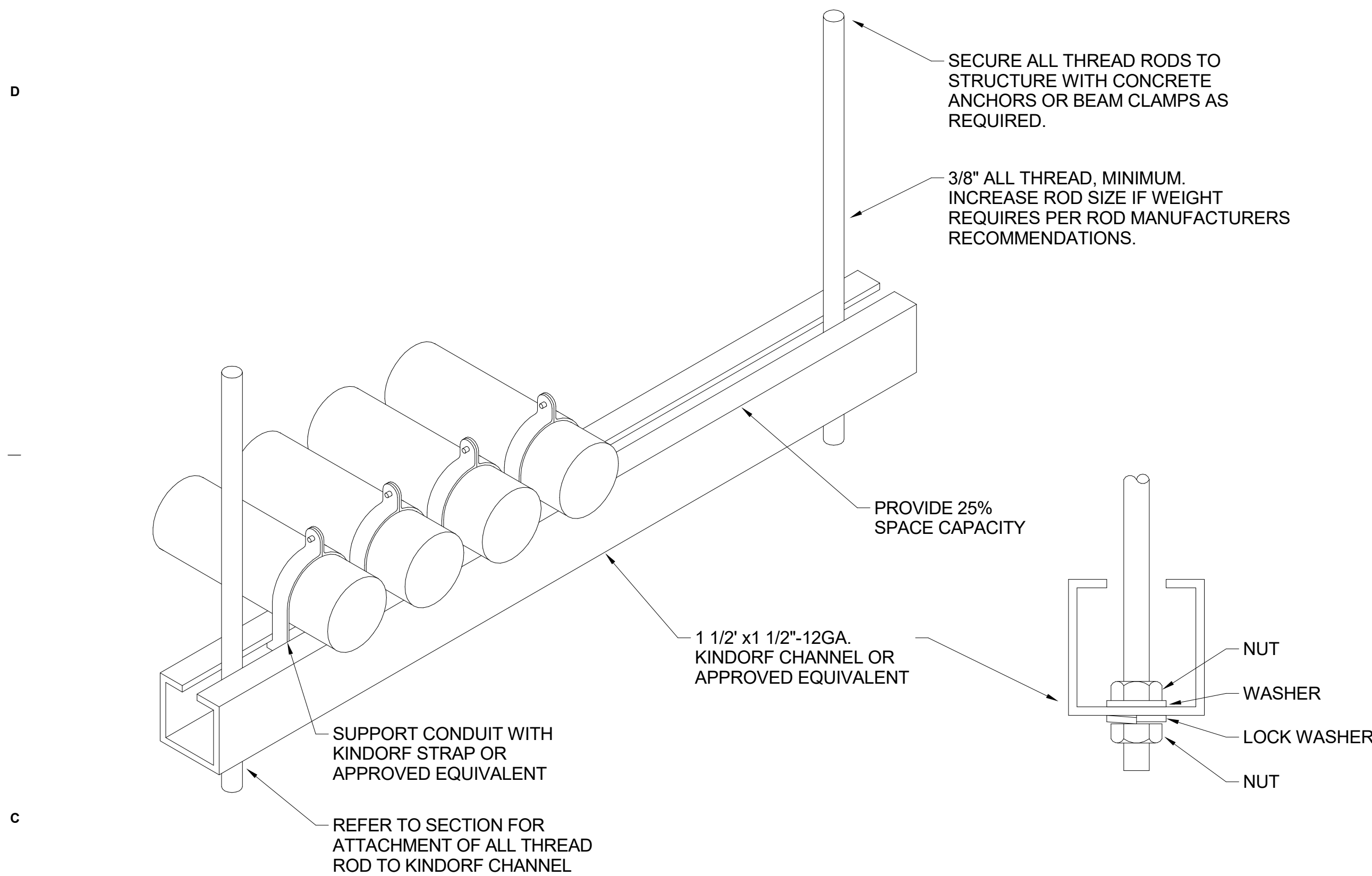
KIRKSEY PROJECT NO. 2024354
KEY PLAN

SHEET TITLE
ELECTRICAL DETAILS

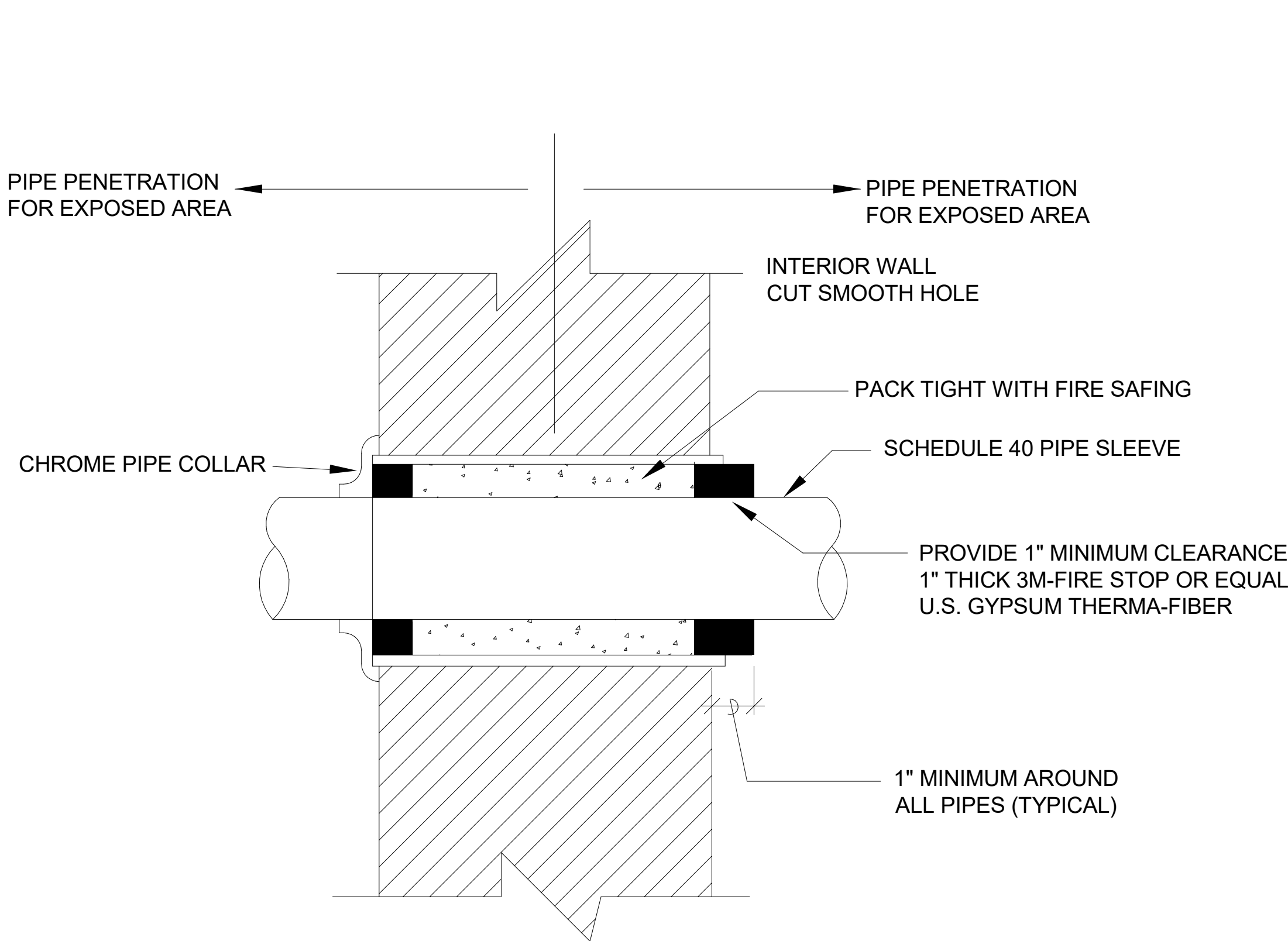
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E8.01

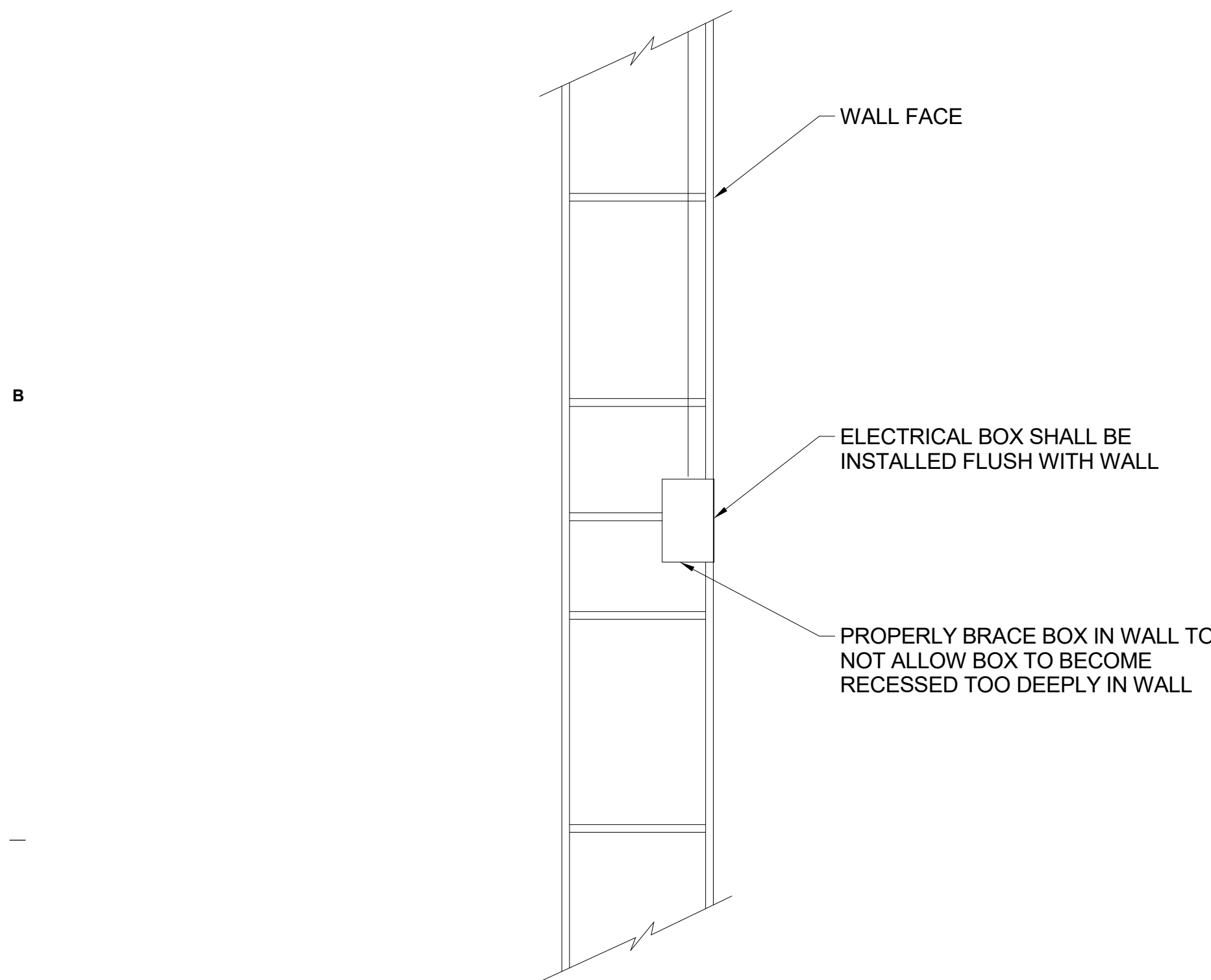
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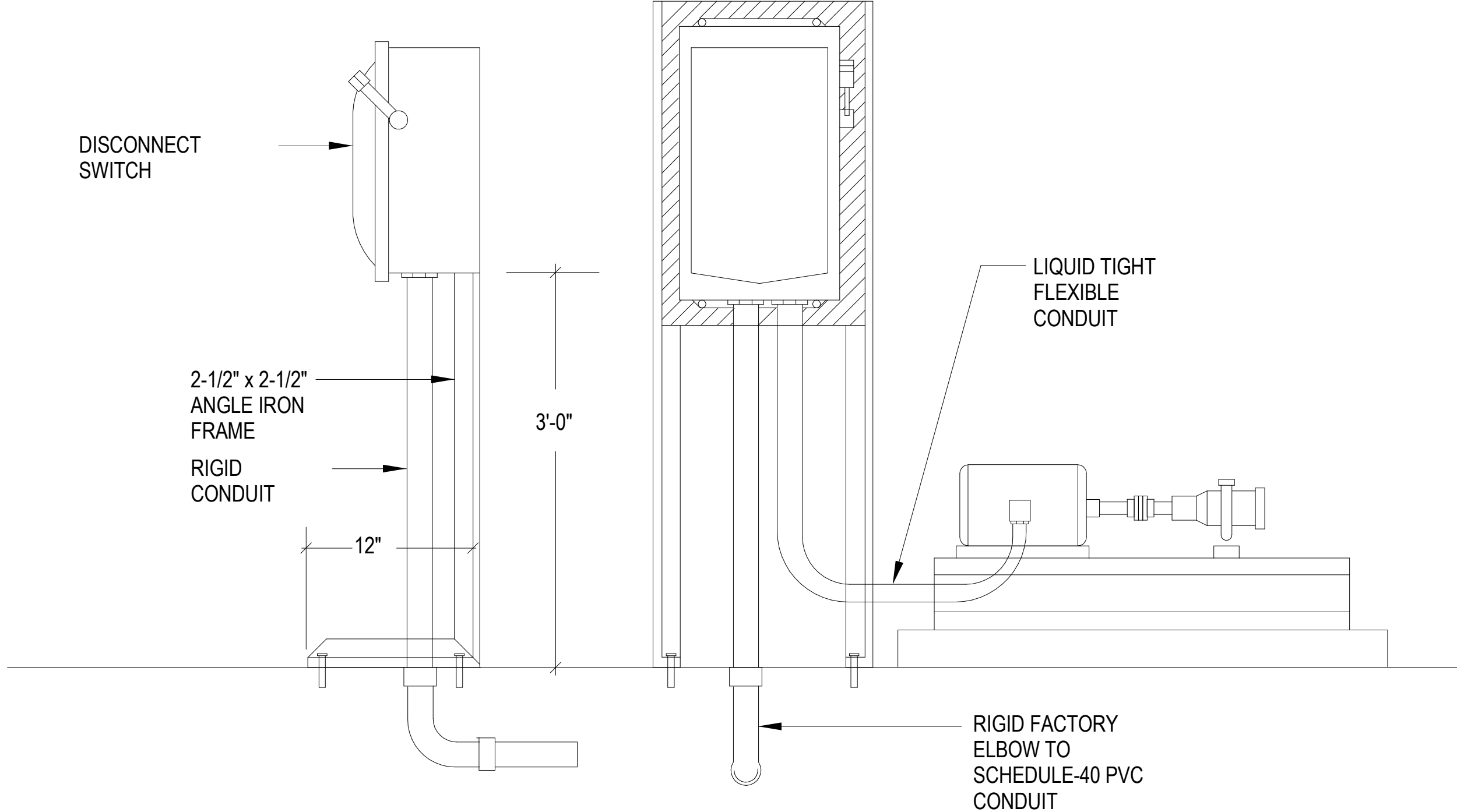
1 TRAPEZE SUPPORT DETAIL
SCALE: NONE



2 CONDUIT FIRE PENETRATION DETAIL
SCALE: NONE



3 DEVICE MOUNTING
SCALE: NONE



4 TYPICAL MOTOR DISCONNECT
DETAIL
SCALE: NONE

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EXISTING MOTOR CONTROL CENTER: MCC				
LOCATION: CHILLER ROOM		VOLTS: 480Y/277V WYE	A.I.C. RATING: 65KAIC	
SUPPLY FROM: EXISTING SERVICE		PHASES: 3	MAIN TYPE: MLO	
MOUNTING: PAD MOUNTED		WIRES: 4W+G	MAINS RATING: 600 A	
ENCLOSURE: NEMA 1				
CKT	CIRCUIT DESCRIPTION	CIRCUIT BREAKER	Load	WIRING AND CONDUIT SIZE
1	EX. CONDENSATE RETURN PUMP	20A	500 VA	EXISTING
2	EX. CONDENSATE RETURN PUMP	20A	500 VA	EXISTING
3	EX. RETURN AIR FAN	40A	10,000 VA	EXISTING
4	EX. RETURN AIR FAN	20A	10,000 VA	EXISTING
5	EX. CHILLED WATER PUMP	20A	5,000 VA	EXISTING
6	EX. EXHAUST FAN	20A	500 VA	EXISTING
7	EX. CHILLED WATER PUMP	30A	5,000 VA	EXISTING
8	EX. AHU-4	50A	40,000 VA	EXISTING
9	EX. CONDENSER WATER PUMP	30A	5,000 VA	EXISTING
10	EX. CONDENSER WATER PUMP	30A	5,000 VA	EXISTING
11	AHU-1	30A (*)	12,470 VA	3#10, 1#10G, 3/4"C
12	AHU-17	60A	37,500 VA	3#6, 1#10G, 1-1/4"C
13	SPARE		0 VA	
14	SPARE		0 VA	
15	SPARE		0 VA	
16	SPARE		0 VA	
17	SPARE		0 VA	
18	SPARE		0 VA	
19	SPARE		0 VA	
20	SPARE		0 VA	
TOTAL LOAD:			131,470 VA	
TOTAL AMPS:			158 A	
LOAD CLASSIFICATION		CONNECTED LOAD	DEMAND LOAD	PANEL TOTALS
HVAC		49970 VA	49970 VA	
EXISTING LOAD		81500 VA	81500 VA	
				TOTAL CONNECTED LOAD: 131,470 VA
				TOTAL DEMAND LOAD: 131,470 VA
				TOTAL CONNECTED AMPS.: 158 A
				TOTAL DEMAND AMPS.: 158 A
NOTES:				
1. BOLD TEXT INDICATES NEW CIRCUIT AND PROTECTION.				
(*) PROVIDE NEW BREAKER TYPE AND MANUFACTURER TO MATCH EXISTING.				
2. PROVIDE NEW TYPE WRITTEN CIRCUIT DIRECTORY.				

Existing Panel: BB										Volts: 208Y/120V WYE					A.I.C. Rating: 42KAIC					
Location: CHILLER ROOM										Phases: 3					Mains Rating: 225 A					
Supply From: EXISTING PANEL "P2-B"										Wires: 4 W+G					MCB Rating: 225 A					
Mounting: Surface																				
Enclosure: Type 1																				
CKT	Circuit Description	# of Runs	P	N	G	C.	Trip	Poles	A	B	C	Poles	Trip	C.	G	N	P	# of Runs	Circuit Description	CKT
1	EX. CATHODES TO DIESEL TANK	--	--	--	--	--	20 A	1	500 VA	1500 VA			1	20 A	--	--	--	--	EX. MICROWAVE	2
3	EX. RECEPTACLES	--	--	--	--	--	20 A	1			720 VA	540 VA		1	20 A	--	--	--	EX. RECEPTACLES	4
5	EX. RECEPTACLES	--	--	--	--	--	20 A	1					540 VA	540 VA	1	20 A	--	--	EX. RECEPTACLES	6
7	EX. RECEPTACLES	--	--	--	--	--	30 A	1	720 VA	540 VA			1	20 A	--	--	--	--	EX. RECEPTACLES	8
9	EX. RECEPTACLES	--	--	--	--	--	20 A	1			540 VA	500 VA		1	20 A	--	--	--	EX. CONTROL PANEL PUMP	10
11	EX. RECEPTACLES	--	--	--	--	--	20 A	1					900 VA	180 VA	1	20 A	--	--	EX. RECEPTACLE	12
13	EX. RECEPTACLES	--	--	--	--	--	20 A	1	720 VA	1000 VA			1	20 A	--	--	--	--	EX. COMPRESSOR DRYER	14
15	EX. RECEPTACLES	--	--	--	--	--	20 A	1			540 VA	540 VA		1	20 A	--	--	--	EX. RECEPTACLES	16
17	EX. TELE. ROOM RECEPTACLES	--	--	--	--	--	20 A	1					540 VA	1000 VA	1	20 A	--	--	EX. CHILLERS	18
19	EX. BPI & RECEPTACLES @ AHU-4	--	--	--	--	--	20 A	1	1980 VA	720 VA			1	20 A	--	--	--	--	EX. RECEPTACLES	20
21	EX. HALL RECEPTACLES	--	--	--	--	--	20 A	1			900 VA	360 VA		1	20 A	--	--	--	EX. RECEPTACLES	22
23	EX. RECEPTACLES	--	--	--	--	--	20 A	1					900 VA	500 VA	1	20 A	--	--	EX. CONDENSATE PUMP	24
25	EX. RECEPTACLES	--	--	--	--	--	30 A	1	720 VA	1000 VA			1	20 A	--	--	--	--	EX. TLS-250 TO DIESEL TANK	26
27	EX. RECEPTACLES	--	--	--	--	--	30 A	1			720 VA	180 VA		1	20 A	--	--	--	EX. ELEVATOR PIT RECEPTACLE	28
29	EX. RECEPTACLES	--	--	--	--	--	20 A	1					900 VA	540 VA	1	20 A	--	--	EX. RECEPTACLES	30
31	EX. RECEPTACLES	--	--	--	--	--	20 A	1	900 VA	0 VA			1	20 A	--	--	--	--	SPARE	32
33	EX. RECEPTACLES	--	--	--	--	--	20 A	1			540 VA	0 VA		1	20 A	--	--	--	SPARE	34
35	EX. RECEPTACLES	--	--	--	--	--	20 A	1					540 VA	0 VA	1	20 A	--	--	SPARE	36
37	EX. CELL PHONE OPERATOR	--	--	--	--	--	70 A	3	8333 VA	0 VA			3	20 A	--	--	--	--	SPARE	38
39	--	--	--	--	--	--	--	--	--	8333 VA	0 VA			--	--	--	--	--	--	40
41	--	--	--	--	--	--	--	--	--				8333 VA	0 VA	--	--	--	--	--	42
43	EX. RECEPTACLES	--	--	--	--	--	20 A	1	720 VA	500 VA			1	20 A	--	--	--	--	EX. CONTROLS AHU#4/PIT LIGHTS	44
45	EX. RECEPTACLES	--	--	--	--	--	20 A	1			540 VA	720 VA		1	20 A	--	--	--	EX. ELECTRONICS SHOP	46
47	EX. RECEPTACLES	--	--	--	--	--	20 A	1					0 VA	250 VA	2	40 A	--	--	EX. A/C PHONE ROOM	48
49	EX. AHU-3 BPI	--	--	--	--	--	20 A	1	1800 VA	250 VA			--	--	--	--	--	--	--	50
51	EX. ELECTRICAL CIRCUIT	--	--	--	--	--	20 A	1			0 VA	540 VA		1	20 A	--	--	--	EX. RECEPTACLES	52
53	CRP-1	1					20 A	1					180 VA	360 VA	1	20 A	--	--	EX. RECEPTACLES	54
55	SUPPLEMENTAL POWER FOR AHU-1	1					20 A	1	500 VA	180 VA			1	20 A	--	--	--	--	EX. RECEPTACLE ELEVATOR	56
57	SPARE	--	--	--	--	--	20 A	1			0 VA	0 VA		1	20 A	--	--	--	SPARE	58
59	SPARE	--	--	--	--	--	20 A	1					0 VA	0 VA	1	20 A	--	--	SPARE	60
61	SPARE	--	--	--	--	--	20 A	1	0 VA	0 VA			0 VA	0 VA	1	20 A	--	--	SPARE	62
63	SPARE	--	--	--	--	--	20 A	1			0 VA	0 VA		1	20 A	--	--	--	SPARE	64
65	SPARE	--	--	--	--	--	20 A	1					0 VA	0 VA	1	20 A	--	--	SPARE	66
67	SPARE	--	--	--	--	--	20 A	1	0 VA	0 VA			1	20 A	--	--	--	--	SPARE	68
69	SPARE	--	--	--	--	--	20 A	1			0 VA	0 VA		1	20 A	--	--	--	SPARE	70
71	SPARE	--	--	--	--	--	20 A	1					0 VA	0 VA	1	20 A	--	--	SPARE	72
73	SPARE	--	--	--	--	--	20 A	1	0 VA	0 VA			1	20 A	--	--	--	--	SPARE	74
75	SPARE	--	--	--	--	--	20 A	1			0 VA	0 VA		1	20 A	--	--	--	SPARE	76
77	SPARE	--	--	--	--	--	20 A	1					0 VA	0 VA	1	20 A	--	--	SPARE	78
79	SPARE	--	--	--	--	--	20 A	1	0 VA	0 VA			1	20 A	--	--	--	--	SPARE	80
81	SPARE	--	--	--	--	--	20 A	1			0 VA	0 VA		1	20 A	--	--	--	SPARE	82
83	SPARE	--	--	--	--	--	20 A	1					0 VA				--	--	SPARE	84
Total Load:									22583 VA	16213 VA	16203 VA									
Total Amps:									188 A	135 A	135 A									
LOAD CLASSIFICATION										Connected Load	Demand Factor	Estimated Demand	Panel Totals							
HVAC										500 VA	100.00%	500 VA								
RECEPTACLE										180 VA	100.00%	180 VA	Total Conn. Load: 54999 VA							
EXISTING LOAD										54319 VA	100.00%	54319 VA	Total Est. Demand: 54999 VA							
													Total Conn.: 153 A							
													Total Est. Demand: 153 A							
Notes:																				
1. BOLD TEXT INDICATES NEW CIRCUIT AND PROTECTION.																				

SAFETY SWITCH SCHEDULE						
EQUIPMENT SERVED	AMPERAGE RATING	VOLTAGE RATING	POLES	DUTY LISTING	NEMA RATING	FUSE SIZE
AHU-1	30	480	3	HEAVY	1	30
AHU-17	60	480	3	HEAVY	1	60

*FUSE SWITCH AT EQUIPMENT MANUFACTURER'S RECOMMENDATION



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PROJECT ADDRESS
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DALLAS, TX 75202

KIRKSEY PROJECT NO. 2024354

KEY PLAN

SHEET TITLE
ELECTRICAL SCHEDULES

SHEET NUMBER

E9.01

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Company Name	Legal Name	Owner Name	Email Address	Email Address 2	Address	Address 2	City	State	Zip Code	Phone Number	Fax Number
238220											
1-A Fire & Domestic Testing	1-A Fire & Domestic Testing	Regina Wagoner	office@mrbackflowtx.com	oneafire@me.com	126 County Road 4577		Boyd	TX	76023	817-232-5577	817-232-5722
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3G Fire Protection, LLC		Michelle Rice	michelle@3gfire.com	michelle@3gfire.com	1753 Laguna Bay		Azle	TX	76020	817-614-6179	
Accurate Fire Systems & Services, LLC		Kimberly Davis	kdavis@accuratefss.com		606 Business Parkway		Richardson	TX	75081	214-799-5342	
ACH SOURCE, LLC		Victor Jackson	VICJACKSON@ACHSOURCE.COM	VICJACKSON@ACHSOURCE.COM	3210 Dogwood Trail		Rowlett	TX	75088	214-498-6355	972-877-8326
Agave Plumbing, Inc.		Julio Medina	julio@agaveplumbing.com	fabi@agaveplumbing.com	2772 W Commerce St.		Dallas	TX	75212	214-689-0496	
Aire Frezzo, LLC		Lissa Magallanes	service@airefrezco.com	service@airefrezco.com	7104 New York Ave.		Arlington	TX	76002	(682)252-4060	(682)895-0383
AIR-KOOL HEATING & AIR, LLC		Otilio Banda	AIRKOOLHAC@ATT.NET	AIRKOOLHAC@ATT.NET	1223 Crestdell Dr	STE C	Duncanville	TX	75137	972-296-0550	
Alpha Heating & Cooling llc	Alpha Heating & Cooling	Natalie Ortiz	ALPHAHVAC@MAIL.COM	ALPHAHVAC@MAIL.COM	1910 PACIFIC AVE	12000	DALLAS	TX	75201	972-886-7433	
Amigo Services, Inc.		Jessica Alcalá-Palomo	amigoservices@sbcbglobal.net	amigoservices@sbcbglobal.net	629 Space Way Dr		Duncanville	TX	75137	214-501-0572	214-501-0572
Andrews Capital Cooling LLC	Andrews A/C	Keesha Andrews	keesha.andrews@gmail.com	keesha.andrews@gmail.com	203 Southeast I-35		Desoto	TX	75203	214-388-7433	
ANS Plumbing Co. LLC		Nancy Sandoval	nancy.sandoval@ansplumbingco.com	nancy.sandoval@ansplumbingco.com	1917 Carrington Dr.		Glenn Heights	TX	75154	469-807-6525	
ARROW INSULATION COMPANY INC.		Debbi Akins	debbi@arrowinsulationinc.com	debbi@arrowinsulationinc.com	844 WALLACE DR STE 19		MESQUITE	TX	75149	972-288-2464	972-288-2465
Assured Mechanical Solutions, LLC		Byron Bailey	byron@amsdfw.com	sonya@amsdfw.com	955 Cedarview Dr		Cedar Hill	TX	75104	972-291-2653	214-228-7096
Atco EnviroAir Testing Engineers, Inc		Mustafa Abdulali	atco121@yahoo.com	mustafa@atcoenviroair.com	2104 McDaniel Circle		Plano	TX	75075	972-985-5564	972-985-5564
BEACH PLUMBING, INC.		Amanda Beach	amanda@beachplumbinginc.com	amanda@beachplumbinginc.com	7452 Dogwood Park Drive		RICHLAND HILLS	TX	76118	817-284-7640	817-284-9640
Chrome Heating & Air Conditioning, LLC		Olusanya Michael Olaleye	olusanya@chromeairconditioning.com		1110 Summit Ave.	Ste 8	Plano	TX	75074	469-252-0599	972-898-3292
Clean Air Mechanical Services Inc	Clean Air Services	Jesus Garcia	jesus@cleanairsvcs.com	jesus@cleanairsvcs.com	3219 S Peachtree Rd	Suite 162	Balch Springs	TX	75180	214-207-8464	
Concept Facility Services, LLC		Clifford Freney	freney@conceptsvcs.com	genika@conceptsvcs.com	646 E. Hwy 67		Duncanville	TX	75137	972-298-8300	972-880-3471
Cool Now LLC		Donald Terrell Jones	coolnowac@att.net		2850 S State Highway 161	Ste 160-136	Grand Prairie	TX	75052	(469)818-5121	(214)908-0231
Daisy Utilities LLC		Daisy Guamanclara	daisy@daisyutilities.com	daisy@daisyutilities.com	415 Timberbend Trl		ALLEN	TX	75002	469-210-7100	972-372-0631
Denali Construction Services, LLC		Michelle Thraikill	michelle@denalics.com		1645 WALLACE DR	SUITE 100	CARROLLTON	TX	75006	214-350-9555	214-304-9717
Discount Air Conditioning and Heating		Rayfield Maxie	discountairandheat@yahoo.com	maxieray@sbcbglobal.net	4016 S Marsalis Ave.		Dallas	TX	75216	214-371-2226	972-365-3278
Elevated Solutions Team LLC		Alonzo Hill Jr.	ah01@elevatedsolutionsteamllc.com	listings@elevatedsolutionsteamllc.com	2550 Pacific Ave.	Ste 700	Dallas	TX	75226	972-850-8544	(972)310-1661
Elliott Refrigeration and HVAC LLC		Avalon Grant-Elliott	avelliott@gmail.com	elliottrefrigerationhvac@gmail.com	4832 Aidan Ct		Fort Worth	TX	76244	817-807-1581	
Endur Contractors, LLC		Loren Todd Rodriguez	trdriguez@endurcompanies.com	gnise@endurcompanies.com	4750 Kennedale New Hope Rd		Fort Worth	TX	76140	817-561-5882	817-217-4916
Envision Landscape Group		Lauren Little	lauren@envisiongroupux.com		2222 Valwood Parkway		Farmers Branch	TX	75234	972-776-2222	
Erasmio's Sprinklers		Erasmio Zapata	erasmozapata353@gmail.com	erasmozapata353@gmail.com	1314 San Miguel Dr		Duncanville	TX	75137	214-664-5621	
EXCEL AIR LLC	Garland Heating and Air Conditioning	JASPREET KHOKHER	jaspreet@garlandheatingandair.com	jaspreet@garlandheatingandair.com	2113 S GARLAND AVE		GARLAND	TX	75041	972-278-3500	
Farwell Sheet Metal, LLC		TAMMY MCCARTHY	tammy@mwitx.com	info@farwellmetal.com	604 Shelby Rd		Fort Worth	TX	76140	817-781-0769	
Fix-A-Drip Plumbing INC		Carlos Hernandez	ana.barrios@fix-a-drip.com	ana.barrios@fix-a-drip.com	8747 Blossom Ln		Dallas	TX	75227	469-708-7703	
Fultonair Service, LLC	Cowboy Air Condition & Heating Co	Alfred Fulton	alfulton@cowboyair.com	alfulton@cowboyair.com	13575 GOLDMARK DRIVE	STE A106	DALLAS	TX	75240	214-570-1540	214-570-1542
GARNET DYNAMICS, INC.		Gretchen Gerken	gretchen@garnetdynamics.com	gretchen@garnetdynamics.com	7027 Twin Hills Ave	Suite 200	Dallas	TX	75231	214-694-2333	214-368-5516
Grate 1 Insulation Service Co., LLC		Daniel D. Grate	grate.1@flash.net		1630 Falcon Dr	Ste 104	Desoto	TX	75115	972-223-8108	214-562-7458
Greycon, Inc.		Gregory Sakwa	admin@grey-construction.com	admin@grey-construction.com	1609 WOLF CREEK DR		ARLINGTON	TX	76018	817-307-8791	817-468-0064
H.V.A.C. Service Pro		Albert Vasquez	albertv@serviceprodfw.com	albertv@serviceprodfw.com	3134 SE Loop 820		Fort Worth	TX	76140	682-703-1242	
Haynes-Humphrey JV		Jerry Haynes	jehc@sbcbglobal.net	lorim@teamhumphrey.com	1730 Maryland Ave.		Dallas	TX	75216	214-941-3574	214-946-2221
HER Plumbing Co.		LaQueena Johnson	herplumbingco@gmail.com	herplumbingco@gmail.com	3010 LBJ Fwy	#1200	Dallas	TX	75234	469-770-7555	855-769-3834
Highland Fire Protection Company		James Garcia	garcia@highlandfire.com	accounting@highlandfire.com	3100 Premier Dr	Ste 200	Irving	TX	75063	972-600-8334	817-201-6741
Hilbash Investment LLC	DFW Roofer and construction	Hamd Abusaad	oshaman325@hotmail.com	oshaman325@hotmail.com	11220 Grader St, Suite 500		Dallas	TX	75238	214-994-8161	469-298-2383
Hillside Mechanical Contractors LLC		Tyronne Burnett	tyburnett@hillsidemechanicalcontractors.com	service@hillsidemechanicalcontractors.com	1501 Jesse Ramsey Blvd		Cedar Hill	TX	75104	469-571-7060	
Hopper Air Conditioning & Heating Co.		Kenneth W. Hopper	amanda@hmfcs28.com	1401 TI Blvd		Ste C	Richardson	TX	75081	(469)730-3129	214-331-6177
HVAC-R FINEST LLC		Junior-Seng Dikousman	junior@hvacrfinest.com	1601 Osprey Drive suite 204		STE 204	DeSoto	TX	75115	972-372-4458	000-000-0000
HVACR SERVICES INC	Texas Air Mechanical	Rosemarie Gloria	rgloria@texasairmechanical.com	1103 Keller Pkwy		Suite 301	Keller	TX	76248	972-223-1532	
Ingram Property Management LLC	IPM Construction	Ronald Ingram	ringram@ipmco.com	ringram@ipmco.com	3754 Morningview Dr.		Dallas	TX	75241	214-957-0609	972-224-9395
Innovative Air, LLC		Ibo Hall	innovativeair1@gmail.com	5342 W Vickery Blvd			Fort Worth	TX	76107	817-966-2665	817-707-9996
Insight Heating & Air Conditioning, LLC		Martin Mata	martin@insightairtx.com	1902 Reserve St			Garland	TX	75042	469-249-0632	
Integra Fire Protection, LLC		Jose Mendoza	jose@integralfireprotection.com	roger@integralfireprotection.com	11120 Petal St.	Ste 500	Dallas	TX	75238	214-613-2146	214-613-2146
J & C Sandoval Plumbers, LLC		Misty MARTIN-SANDOVAL	misty.sandoval@sandovalplumbers.com	jesus.sandoval@sandovalplumbers.com	4269 Elkins Ave.		Lancaster	TX	75134	(214)799-1427	(469)383-2989
JaCom Enterprises, LLC		Suzanne Woods	jacomenterprises@gmail.com		1405 Wheatberry Lane		Allen	TX	75002	214-673-5451	469-742-0382
Kahn Air Conditioning & Heating Co.	Kahn Mechanical Contractors	Charlotte Kahn	ckahn@kahnmechanical.com	ckahn@kahnmechanical.com	2787 Irving Blvd		Dallas	TX	75207	214-631-1010	214-951-9699
KBR Commercial Building Services, LLC		Keith Robinson	keith.robinson@kbrcb.com	5680 Peterson Ln		Ste 125	Dallas	TX	75240	(972)374-8562	(972)374-8562
Kennedale/Mansfield Plumbing, Inc.		Rachael Cummings	rcummings@kmpcorp.com		1451 Heritage Parkway		Mansfield	TX	76063	817-453-8028	817-645-9599
Koot Mechanical Group, LLC		Rayo Bretado	carlos.i.ruiz89@gmail.com	2751 Grafton Ave			Dallas	TX	75211	214-607-8437	972-697-8224
LG Mechanicals Heating & Air		Daisy Reyes	info@lgmechanicalservice.com	info@lgmechanicalservice.com	1220 W Hammond St		Fort Worth	TX	76115	682-583-7747	
Mahnah LLC		Oluwaseyi Oyediran	mahnahlc@gmail.com	mahnahlc@gmail.com	11837 HENDERSON DRIVE		Frisco	TX	75035	469-536-4254	
Marsh RDR RAM Contracting LLC dba RAM Contracting		Ray Marsh	rmarsh@ram-contracting.com	dmarsh@ram-contracting.com	6115 Owens St.	Ste 209	Dallas	TX	75235	972-744-6434	469-556-6358
MC2 Energy Management, INC	S&A Fire & Safety	Marcus Aguilar	marcus@safiresafety.com	maguilar@safiresafety.com	3535 Interlaken Dr	Suite 100	Plano	TX	75075	469-576-3236	214-889-5501
MEP Consulting Engineers, Inc.		Shahin Nemati	snehati@mepec.com	snehati@mepec.com	6341 Campus Circle Dr. E.		Irving	TX	75063	972-870-9060	972-870-9056
Momentum Mechanical, Inc.		Mark Rutledge	mrutledge@momentummechanical.com	mkelleey@momentummechanical.com	2504 Gravel Dr		Fort Worth	TX	76118	817-624-0024	972-571-1045
My HVAC Guy LLC		Kelton Lisby	info@myhvacyguy.com	info@myhvacyguy.com	5140 Mirror Lake Dr		Haltom City	TX	76117	817-217-3120	
Native Solutions, Inc.		James M. Barnett	jbarnett@nativesolutionsinc.net	smiller@nativesolutionsinc.net	1400 S Sherman St.	Ste 120	Richardson	TX	75081	(214)608-2344	214-608-2344
Nickleberry Heating & Air, LLC		Jeremy Nickleberry	nickleberryheatingair@outlook.com		524 Campana Ct		Irving	TX	75061	972-795-9863	972-795-9863
Nomis Heat & Air LLC		TYRONE NORRIS	service@nomisheatandair.com	cautry@ntdmmechanical.com	1508 E Beltline Rd Ste 102		Carrollton	TX	75006	214-254-6701	
North Texas Ductworks, LLC	NTD MECHANICAL	Carmen Autry	cautry@ntdmmechanical.com	cautry@ntdmmechanical.com	2477 Merritt Drive		Garland	TX	75041	469-323-0454	
OAK POINT HEATING AND AIR LLC		ERIC CURRY	oakpointvac@yahoo.com	oakpointvac@yahoo.com	3447 Farm to Market Rd 720 #11		Little Elm	TX	75068	940-208-4300	
Ocasas Heat & Air, LLC	Summer Dreams A/C Repair	David Ocasas	summerdreamsacrepair@gmail.com	summerdreamsacrepair@gmail.com	204 MABRY LN		Red Oak	TX	75154	972-951-2480	
POFSS LLC dba Professional Choice Fire and Security Systems		Dwandel Walker	dwanald@professionalchoicefire.com	karen@professionalchoicefire.com	1815 N Hampton Ln		DeSoto	TX	75115	972-298-2303	214-535-3269
Precision Climate, LLC		Benjamin Childress	precision.climate@live.com	precision.climate@live.com	1628 Panama Pl		Dallas	TX	75215	972-839-2722	
PRG Mechanical LLC		Phillip Garcia	phil@prgmechanical.com	pkgarca2016@gmail.com	2613 Sagebrush Dr	Suite 101	Flower Mound	TX	75028	(972)649-4115	(904)864-3170
REKJ Builders, LLC		Ray King Jr	REKJBuilders@gmail.com	REKJBuilders@gmail.com	9205 Royal Burgess Dr		Rowlett	TX	75089	214-680-7211	214-594-5816
REYES HVAC SERVICES LLC		Rodolfo E. Reyes	ereyes@reyeshvacservices.com	ereyes@reyeshvacservices.com	1440 W SHADY GROVE RD		IRVING	TX	75060	214-223-5108	972-790-3460
RHS AC SERVICES, LLC		ANTIWANETTE ROBINSON	office@rhsacservices.com	office@rhsacservices.com	915 Moon Deck Trail		Lucas	TX	75002	214-901-7548	
Romo Life Safety & Construction, LLC		Andres Romo	andy@romolifeyesystems.com	mgomez@romolifeyesystems.com	1323 Fleetwood Cove Dr		Grand Prairie	TX	75052	972-742-0081	972-742-0081
Ruiz-Boyer Construction & Supplies, LLC		Silvia Adams	silvia@ruiz-boyer.com	edna@ruiz-boyer.com	615 Six Flags Dr		Arlington	TX	76011	972-780-5951	214-566-9598
RushCo Energy Specialists, Inc.		Anne RUSHER	tim@rushomechanical.com	arusher@rushomechanical.com	10765 Tube Drive		Hurst	TX	76053	817-267-5155	817-510-1905
Select Maintenance, LLC		Troy Ragle	rgabe@selectcompanyllc.com		9003 Airport FRWY	G270	North Richland Hills	TX	76180	812-483-6396	817-472-9942
Select Plumbing LLC		Pedro Perez	selectplumbingdallas@gmail.com	selectplumbingdallas@gmail.com	2450 Joe Field Rd Suite 107		Dallas	TX	75229	972-685-5387	
TEMP PRO MECHANICAL, INC.		DANIEL MARTINEZ	daniel@tempromechanical.com	daniel@tempromechanical.com	416 NE 28TH ST		GRAND PRAIRIE	TX	75050	972-504-2079	
Texas Mechanical Group LLC		Marcela Napper	marcela@texasmechanicalgroup.com		1308 Cannes Drive		Carrollton	TX	75006	214-442-3745	

Whitecap, LLC	Whitecap Mechanical	Roger Inojosa	rinojosa@whitecapmechanical.com	rinojosa@whitecapmechanical.com	9671 Wendell Rd.		Dallas	TX	75234	972-373-4740	
XSAIL MECHANICAL A/C AND HEATING LLC		John Gibson	Xsail.mchl@gmail.com	Xsail.mchl@gmail.com	3313 Rio Grande rd		Little Elm	TX	75068	214-374-9223	469-777-3419
423730											
Advantage Supply		Carol Bane	carol.bane@advantagesupply.us	carol.bane@advantagesupply.us	6917 Battle Creek Road		Fort Worth	TX	76116	817-377-8094	817-768-2452
Andrews Capital Cooling LLC	Andrews A/C	Keesha Andrews	keesha.andrews@gmail.com	keesha.andrews@gmail.com	203 Southeast I-35		Desoto	TX	75203	214-388-7433	
REYES HVAC SERVICES LLC		Rodolfo E. Reyes	ereyes@reyeshvacservices.com	ereyes@reyeshvacservices.com	1440 W SHADY GROVE RD		IRVING	TX	75060	214-223-5108	972-790-3460
SATURN ENTERPRISES, INC.		MARIA MENZIES	maria.menzies@hvacsaturn.com	maria.menzies@hvacsaturn.com	27 YORK DR.		FORT WORTH	TX	76134	817-293-8059	
Triton Supply, Inc		Traci Gervase	traci@tritonsupply.net	traci@tritonsupply.net	533 Austin St.	Suite 301	GRAND PRAIRIE	TX	75051	214-382-4662	214-382-4663